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Electrical World

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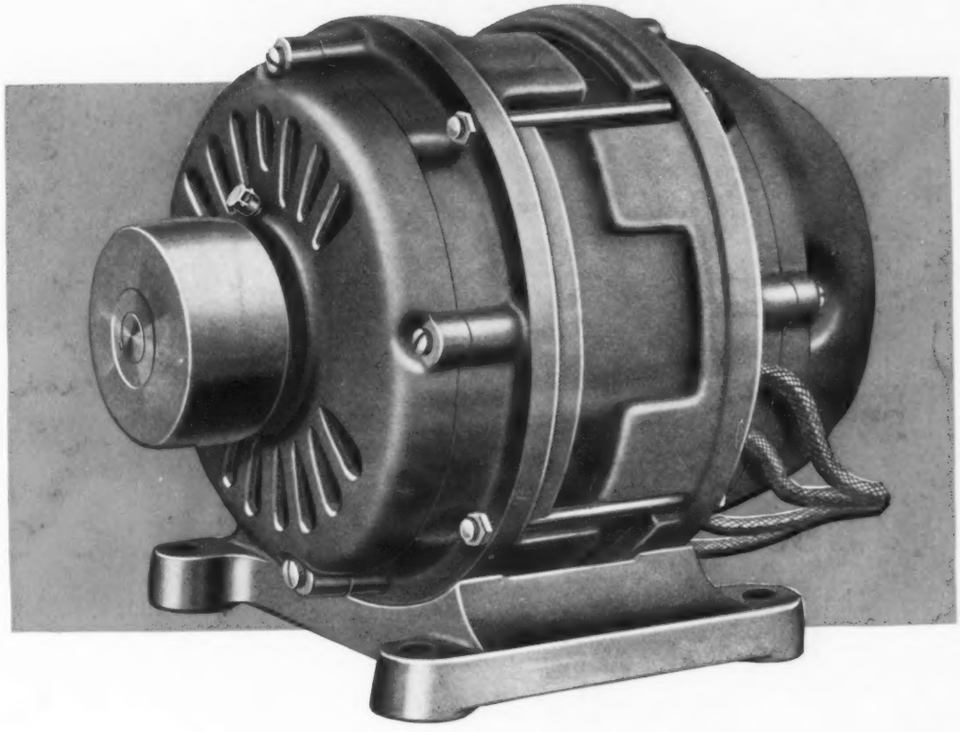

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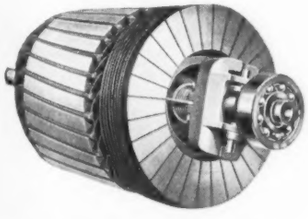

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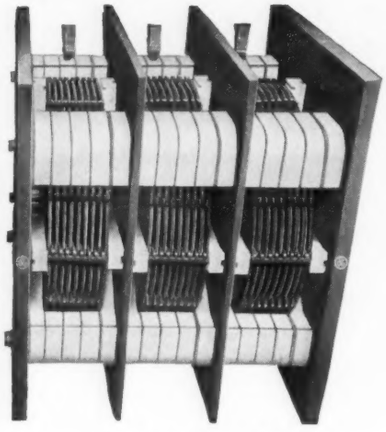

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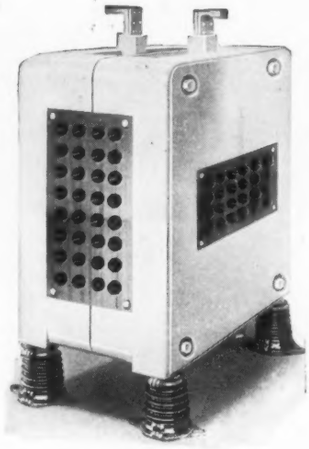

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The Human Side of Economics

WORDS run through the conversation of the world like other fads. One year some thought is front in everybody's mind and the name of it on everybody's tongue. Next year some other idea is ascendant or some other name for the old interest.

Right now all men are talking of economics. The word "efficiency" has given way to the plainer truer term—"elimination of waste." The old admonition "Know your costs!" is linked with it. But today we boil it all down into four convenient syllables and call it "economics." But "economics" has an academic sound and many people are afraid of it.

ECONOMICS means just facts about the cost of doing things. It's not a theoretical study, a matter for professors and financiers to worry about. Rather it is the practical application of prudence, thrift and forward thinking, with the judgment based on facts instead of fancy. For example:

There are today electrical contractors who when they estimate take out an envelope and pencil and virtually figure thus: "Nothing from nothing leaves nothing. Two from one won't come. I'll wire your house for fifty dollars." Economics in this case would mean an estimating sheet suggesting every item, a schedule of material costs, a record of labor experience to aid the guessing.

There are jobbers who encourage or permit their salesmen to devote most of their time to taking orders for the lines that are most easily and quickly sold. Economics for these men would point to the interesting fact that harder-to-sell specialties will often pay higher profits for the same amount of work when linked intelligently with more creative development of the staple market.

There are manufacturers who persist in turning out a vast array of excess varieties. Economics here could show some sensible reasons why it would be better to concentrate on a line of essentials.

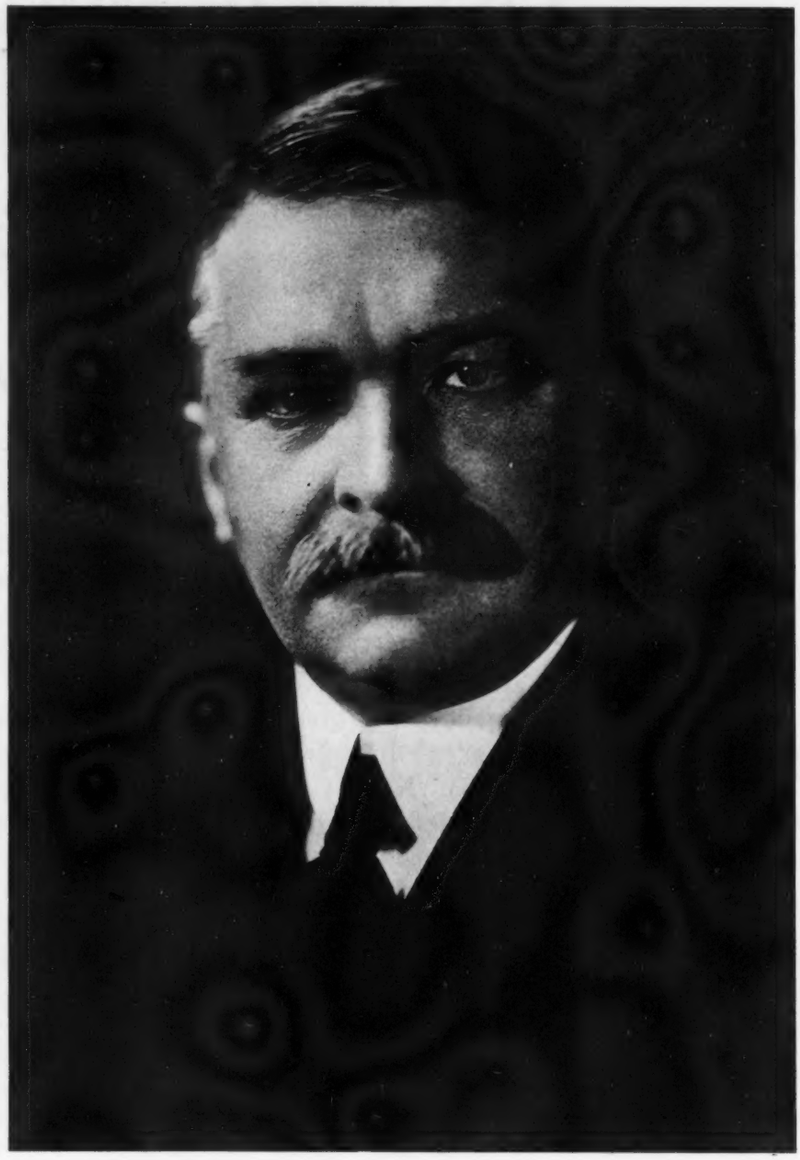
There are central-station men who are forgetful of the burden on the central-station dollar and sell capacity for low-profit business that with effort could be marketed for better earnings. And a little economic thinking here would help.

MEN hasten on and use what they call their "judgment" without facts to base true judgment on. But they can lose more time and waste more money this way on unwise decisions than would ever be expended in securing facts that would guide them safe through. The use of facts on cost, facts on price, facts on market, facts on experience from which a man may tell just what to do —this is the human side of it, the actual thought in this word "economics" that we are using so much nowadays.

Economics is not just a study. It is a principle. It says, "Be frank and fair and sure and don't waste"—this in the interest of yourself, your stockholders and your industry.

Samuel Wesley Stratton

Builder of the Bureau of Standards and a foremost exponent of the advantages of research.



SAMUEL WESLEY STRATTON, who was elected president of the Massachusetts Institute of Technology on Oct. 11, was for twenty-one years director of the Bureau of Standards, Washington. During that time Dr. Stratton built up from a small office of weights and measures, employing three or four persons, a bureau which occupies a dozen buildings, has a staff of more than nine hundred employees and is the largest government laboratory in the world.

Coming from the University of Chicago in 1901, where he was professor of physics, Dr. Stratton immediately began the establishment of the Bureau of Standards as a center of scientific research. American industry during these twenty years has seen many changes. At least four industries in the United States may be said to have been created in that period—the automotive industry, the chemical industry, the electrical industry and the motion-picture industry. Dr. Stratton, as the head of the Bureau of Standards, built it up during this period of intensive industrial development not only with a remarkable grasp of the fundamental scientific work that underlay the development of certain features of this industrial growth, but with a many-sided, intimate knowledge of processes, a knowledge which is a continuing source of pleasure to those in industry who have come in contact with the breadth of his knowledge. The bureau under his direction has developed two broad functions aside from its limited start as a repository of the legal standards of weights and measures. First, it has gradually become the research testing laboratory for a great many of the government purchasing departments, and, second, it has gained the function of research for industry. In the second capacity the bureau has a remarkable record of achievement, and in the fields of industry where rule of thumb has been the order it has made many converts to the fundamental soundness of scientific research as a basis for the development of better industrial processes and better products. To facilitate this work four complete manufacturing establishments in miniature were set up at the Bureau of Standards—in textiles, in ceramics, in glass and in paper. One of the outgrowths of the intensive studies in ceramics was of inestimable value to this country during the world war, when the Bureau of Standards furnished from its plant the optical glass for which up to that time this country had been depending on Germany. This is but one instance of Dr. Stratton's practical ability.

Dr. Stratton was born at Litchfield, Ill., July 18 1861. From his Alma Mater, the University of Illinois, from which he was graduated in 1884, he received the honorary degree of doctor of engineering in 1903, and in the same year he received the degree of doctor of science from the University of Pittsburgh, then called the Western University of Pennsylvania. The same degree in 1909 was conferred upon him by the University of Cambridge and in 1919 by Yale University. He is a member of many learned societies. He was made a chevalier of the Legion of Honor in 1909 and is a recipient of the Elliott Cresson medal from the Franklin Institute and of the welfare medal of the National Academy of Sciences.

During the war with Spain Dr. Stratton served as a lieutenant in the navy, and from 1904 to 1912 he was a commander of the District of Columbia Naval Militia. During the world war he was a member of the interdepartmental board of the Council of National Defense and of the National Advisory Committee for Aëronautics.

The Massachusetts Institute of Technology will gain in Dr. Stratton as its head a scientist with deep and wide knowledge of industry and a man who has eminently succeeded in dealing with men and conditions under government administration.

Editorial Comment

Electrical World, October 21, 1922

Volume 80 Number 17

Will Gates Once Closed Be Thoughtlessly Opened?

THERE is a lesson for many who, unfortunately, will not see it in the address of P. S. Arkwright delivered before the Association of Edison Illuminating Companies last week. Stated in a few words, the point he made was this: Many states in early days used their credit freely to construct public works, principally railroads. Subsequent hard, cold experience with government operation of these works, with the attendant political influences, accompanied by actual repudiation of their debts by eleven states, led the citizens of all but four of the states to place constitutional prohibition upon any use of state credit for construction of public works or for any purpose not actually governmental in nature. Now, apparently unmindful of that history, attempts are being made, notably in California, to remove the restrictions so that that which experience taught should not be done may again be done. They are pounding at gates once judiciously closed.

There are many arguments, many facts, many opinions quoted in connection with the present move in California to amend the constitution so that the state may control the water powers. But stronger than all of these, it seems, should be the plain experiences of our own predecessors in connection with similar state ownership of public works. That fact is that it just didn't work. There is no reason to believe that human nature or our governmental organization and methods have undergone any revolution which will permit such things now to be done. A study of the facts as put forth by Mr. Arkwright ought to have an effect upon intelligent voters in California if they can be made available to them for study. Citizens and politicians of other states where the subject is under consideration should also ponder the question with care and study the history of their forefathers.

Waterpower Resources of France Hardly Tapped

AS THE World knows, France has few coal mines in her own territory, and in the war Germany thoughtfully destroyed every coal mine on which she could lay her hands. A certain amount of fuel has been wrung from Germany in reparation for her iniquities, but, with all that, power supply in France is difficult. The available waterpower is considerable, reaching nearly 2,500,000 hp. in the main river basins. A very much larger amount could be obtained from mountain streams, mostly rather small. Some 800,000 hp. was in use before the war. While France is unusually rich in small developments for local use throughout the country, the big waterpowers have not yet been developed, although the Rhone with a full capacity of 1,700,000 hp. is on the way to reasonably prompt development. A project is now on foot for a corporation privately owned, but with the government as a responsible partner, which will undertake the very serious cost of the total development.

Most of the power of the Rhone lies in its upper reaches, and, as our readers are well aware, the development here considered, especially for the supply of Paris, has been several times investigated with a good deal of care. It was in behalf of the long transmission which would be involved that rather elaborate experiments were undertaken some years ago with the constant-current system, utilizing ground return in a pinch, the project at that time being directed toward an underground transmission line. What form the present project will take is as yet uncertain, but this much is clear, that the Rhone, especially in its proper reaches, has available power to a very large amount, a considerable portion of which can be utilized without forbidding expense.

The project as now outlined implies a more complete development than has been considered in previous stages of investigation, including considerable expense for navigable waterways and irrigation. It would, in fact, open up a barge canal from the Mediterranean to the Lake of Geneva, and from Marseilles to Strasbourg. The scheme is far from being fully under way, but it has reached the stage where there seems to be a strong probability that the splendid resources of the Rhone will ere long be turned to something like full account.

Reckoning the Cost of Daylight

THE Illuminating Engineering Society convention paper by Luckiesh and Holladay dealing with the cost of daylight stirs up a question which is of real importance in modern city planning. It extends in fact not only to large industrial or office buildings, but even to hotels and residences. In its larger aspect the problem is this: Given ground space for a substantial skyscraper, say 20,000 square feet, how much of such space does it pay to reserve for light wells or their equivalent, looking at the matter in all its aspects and reckoning the full cost of daylight lighting and also of artificial lighting at current rates? Of course, it will readily be granted that to the degree in which outside lighting can conveniently be obtained without sacrificing of ground space it is always worth obtaining; but in the inner portions of the available space the loss of floor area due to a light well is serious, and the effectiveness of such a well in the case of very tall buildings becomes dubious unless considerable area be sacrificed. Therefore is it not wise to depend more upon artificial light than we have of late been in the habit of doing?

Few people realize that window space costs in dollars and cents more than wall space. This is true not only in the case of an industrial building with highly specialized

steel window frames, but as regards a common frame house. Moreover, the amount of heat required in our climate during a considerable part of the year is greatly increased when very liberal window space is provided. Heat is lost through the windows much more rapidly than through the walls, and consequently more must be furnished. Repairs, renewals and cleaning of windows also rise to a very perceptible figure, so that, including the interest on the investment, the authors find that, speaking in general terms, the total annual costs of lighting by window spaces and by artificial light are usually not widely different, while in not a few instances artificial lighting carried to the point indicated by good modern illuminating practice is actually cheaper than natural light.

This is not at all to offer the suggestion that we had better do without windows entirely unless they are needed for ventilating purposes, but to show that in cases where ground space is valuable and the uses of a building are such as permit of effective artificial lighting such light may be not only economical, but on the whole quite as desirable as natural lighting. If a building is to be used for industrial purposes, experience shows that without great sacrifice of ground area it is extremely difficult to get good natural lighting, and it is also a well-known fact that first-class artificial light keeps production up to at least the point reached by the average daylight conditions. It is a curious turn of affairs that has brought about a profit balance on the side of artificial light, a result perhaps of our insistence on crowding together in cities and putting our buildings on end and in contact with each other instead of spreading them out for the maximum benefit of light and air. Society is penalized by this sort of crowding in many ways, but it is a condition and not a theory with which we have to deal, and from present data it looks very much as though the future architect and contractor would have to consider the economic factor of artificial lighting as one bearing somewhat heavily on the utilization of the space at hand.

Analyzing Costs in the Interests of Scientific Rates

IN SPITE of all the past efforts toward computing rates on a rigidly scientific basis, it is hardly mere speculation to assert that a large majority of the published electric rate schedules would, upon investigation, be proved to rest upon tradition or expediency. In relatively few instances could it be demonstrated that the classification of consumers is at the same time fairly complete and completely fair. The cases are not yet the rule where each consumer contributes equitably with the others to the expenses and fair profits of the producers. The measure of inequity which still exists is attributable, ordinarily, to a multiplicity of factors that culminate in a "let-well-enough-alone" attitude on the part of the management. Nor can the attitude or even the results be categorically condemned—in some instances the cost of charging scientifically could easily transcend the benefits, in others the rigidly correct charge would be more than a desirable group of consumers could bear.

Books are kept primarily for the purpose of exhibiting the extent to which the enterprise is solvent and profitable, but they can as well reflect the costs of financing and operating in such form as to permit ready and appropriate allocation among classifications. Three members of the Iowa Railway & Light Company staff begin in this issue and will continue in a later one their analysis of the costs of serving various users and the necessary modification of the accounting system to facilitate the segregation of costs. Those who have striven for a means of crediting the off-peak consumer without resort to individual treatment will appreciate the ingenious employment of the "peak-responsibility factor." Others may justly question the propriety of dealing with the simple arithmetical difference between kilovolt-amperes of capacity and kilowatts of load as a measure of unused capacity. But all should welcome the impetus to the movement to place, as far as feasible, the assessments more generally in proportion to the benefits. The authors are to be commended for their suggestion that the utilities exchange through the press more data on the factors that affect rates. Much is now known, but inaccessible, that would contribute immeasurably to the determination of demand factors, diversity factors and the more recent "peak-responsibility factor" and to their proper application in the precise fixing of rates.

The Breakdown of Insulation

INSULATION is the weakest element in every electric machine or system. Short-radius curvature, sharp bends and mechanical vibration impose severe mechanical burdens on substances which demand by their nature and function the gentlest treatment possible. Nor is this the worst of it. For it may be said with almost equal truth that this is also the element that we know least about. Perhaps this ignorance is the cause of the trouble, and in some far future day we may know the nature of dielectric properties and the mechanism of breakdown and be able to control the structure of insulation and predict its life.

For the present, however, insulation is the greatest problem of the manufacturer and the greatest challenge to the investigator. What happens when voltage is applied to an insulator? A slow soaking in of charge, a conduction current, dielectric hysteresis, a change in insulation resistance, the generation of hot spots, and finally failure. But all these things are working together in a relation entirely unknown and apparently varying from point to point. The investigation of each is complicated by the presence of the other. For a long time it has been known that temperature has a most important influence on insulation. Even below the values at which it threatens carbonization or oxidation, temperature variation causes wide changes in insulation resistance and dielectric loss. Hot spots in insulation have long been recognized as precursors of breakdown.

The trend of expert opinion is now apparently to the feeling that conductivity, as affected by temperature, is the cause of breakdown, or at least the method in which the final stages occur. This position was taken by Dr. K. W. Wagner in his A. I. E. E. address last spring, and Messrs. Hayden and Steinmetz develop it still further in this issue, with the aid of several illuminating experimental tests. Their observation is that, owing to the non-homogeneity of insulation, the conductivity current is unevenly distributed, so that if the heat generated is not readily liberated the current will

become excessive in spots, because of the negative temperature coefficient, and eventually cause breakdown due to the pyroelectric effect.

While this observation is very interesting and is valuable information, it does not tell us much of the ultimate nature of dielectrics and their failure. Before we can hope to understand and control their properties we must go much deeper. Water within even the dryest insulation has a most important influence, and H. Evershed has developed an ingenious theory, confirmed by experiment, accounting for the influence of temperature by the behavior of water in minute capillary channels within the insulations. But, as already remarked, the answer is not yet, and it is a task, not for one, but for many careful and trained investigators.

An Excellent Chance for a Good Primary Battery

OF LATE the primary battery seems to have been left out in the cold in reckoning up the electrical family, and yet there are times and places where it has very much to recommend it. One such condition, and a really important one, is to be found in the excitation of the tubes used in radio receiving sets. The conventional equipment at the present time, when one gets beyond the crystal detector stage, usually pretty early in his experience, requires the use of a storage battery. This in and of itself does not sound at all formidable to the man who is familiar with the use of this instrument in his car, but nevertheless the situation is different in a very material degree. It is generally recommended that the owner of a radio set should put his battery in the cellar and wire it to his receiving station. This of itself is not altogether a cheerful prospect, but the isolation of the battery from ordinary living rooms is highly desirable on account of the evil odor and more evil occasional spattering of the acid. Batteries of the kind most readily obtainable weigh anywhere from thirty to sixty pounds and have to be recharged at fairly frequent intervals. This is not difficult in the city when the radio "fan" has a car, but in small towns and in the country maintenance of a storage battery is a good deal of a nuisance. Nothing is more admirable within its limitations, but these cannot altogether be forgotten.

Tubes are now available requiring only a very modest current output, but the source must be reliable. There is certainly a good opportunity in this particular field, which is rather a large one, for a primary battery which is thoroughly reliable, holds up its voltage well and neither smells nor has a tendency to spray acid. Some day batteries will drop out of sight altogether in favor of energy taken from the ordinary electricity supply, but even so the radio set can and will go into a good many places not yet served. There are many possibilities in the primary-battery lines—various forms, for instance, of extra durable and efficient dry cells, improved wet cells of the same Leclanché type and other batteries belonging to the old-line equipment in sources of electricity. One of the very best of these is the Grenet, which, if put up in convenient and not too bulky form, would be a most dependable and convenient source of energy, and others there are which probably could equally well be brought to a modern pitch of efficiency. The broad fact that there is a wide field of usefulness open to a battery which does not require the ministrations of an electrical supply circuit and is at once compact, trustworthy and cleanly in use ought to stimulate engineers, particularly those directly interested in radio, to a new period of activity. Too much of the earlier electrical art has been quite forgotten, and opportunities such as this suggest the advisability of bringing it to memory.

Engineering Problems That Must Not Be Overlooked in Interconnection

WITH all the commendation of the policy of interconnection and the vigorous propaganda carried on in behalf of the "superpower system," it may be well to examine closely to discover wherein interconnection is beset with countervailing difficulties. It is in fact apparent that such are rather easily found, particularly in the matter of the greatly increased plant capacity with which the component members of the interconnected system must deal. For example, if three 10,000-kw. plants are interconnected, there may exist circumstances under which any one of the three will have thrust upon it short-circuit possibilities and switch duties considerably greater than those for which the outfit was originally designed. The chance of surging will be increased with some risk to the insulation, and the interconnected stations must have some coherent system of switching and load dispatching. In any given case these possible disadvantages must be weighed. We are inclined to the opinion that they will usualy be found of comparatively small general significance, although now and then there may be striking exceptions to this rule. To offset the greater possibilities of a short circuit one has the chance of a much higher diversity factor, considerably reduced fluctuations in the joint load and so on.

The chance of trouble in interconnecting old-fashioned and ill-designed systems, however, is not one which can be overlooked. There are a good many plants in the country in which the factor of safety on the insulators is decidedly insufficient. If one of these weakly insulated systems is tied in with one equipped on modern lines and a surge does start, rather serious results may follow. This is especially true if the two systems happen to be near together, and it behooves the owners of an old plant which contemplates tying in to remember something of the Scriptural adage, perhaps now outlawed by the Volstead act, about putting new wine into old bottles. In other words, there is under such circumstances real need for a thorough going over of the older system to eliminate all the weak spots which time has left. In interconnecting plants over great areas the cushioning effect of long lines is often a very valuable asset in avoiding trouble, but the potential gradients possible under surge conditions require considerable examination, lest at some branch, very likely connecting a weak plant with a strong line, so to speak, dangerous conditions may exist.

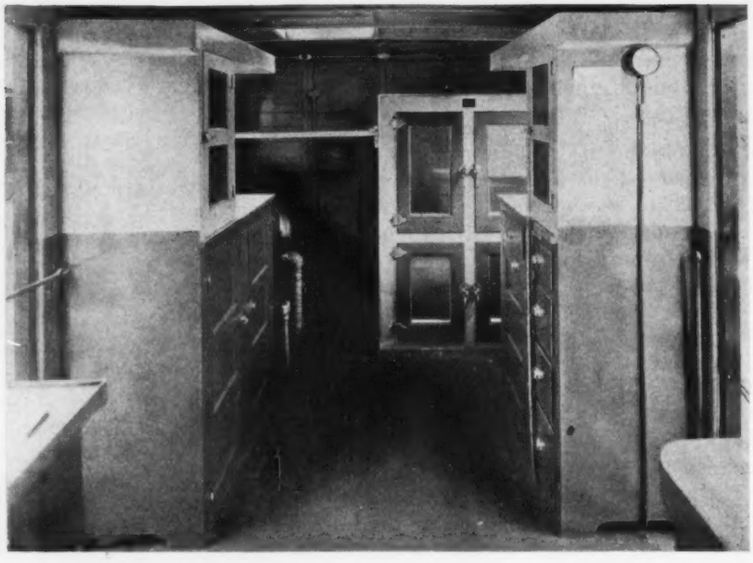
Interconnection is like trying to make two machines do any kind of work harmoniously on the same job; the results are apt to be held within the limitations of the weaker of the two. This is no argument against the principle of interconnection, but it is a clear warning to proceed with care and to regard the engineering as well as the commercial problem as one worthy of study in considerable detail.

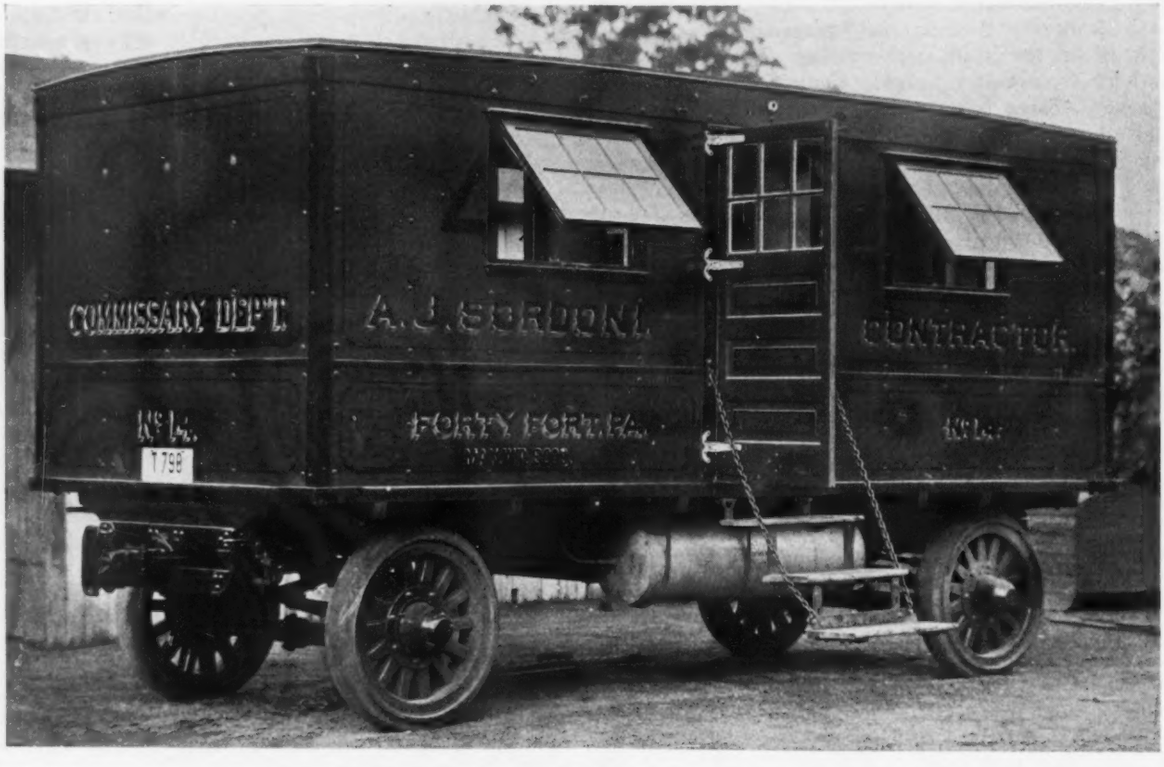
A Portable Camp that Appeals to Construction Men

REALIZING that contented workmen give the best service, A. J. Sordoni, a general contractor in the utility field, has added to the usual construction equipment a portable outfit which serves not only as a kitchen, commissary and refrigerating plant but also as a central utility plant for supplying hot and cold water, electricity and other comforts to the camps of his men. The outfit is mounted on a 5-ton reversible trailer that can be drawn behind one of the trucks used to transport construction equipment. It is shown second in the line of trucks.

In addition to the usual equipment required for a camp kitchen and commissary, the truck is equipped with a 110-volt automatic generator, an electric refrigerating plant and an electric pump for furnishing hot and cold water to the men's tents. These tents as well as the dining tent are lighted by electricity.

Mr. Sordoni says that the men and camp cook appreciate these added conveniences and reflect it in their work. On one transmission-line construction job fifteen men raised and tamped fifty-nine 50-ft. poles in one day.





Insulation Failure—A Pyroelectric Effect

Investigation of Mechanism of Breakdown of Solid Insulation Proves that It Depends Upon Relation Between Heat Production and Heat Dissipation — Time Element Involved — When Puncture Occurs

By J. L. R. HAYDEN and CHARLES P. STEINMETZ
General Electric Company

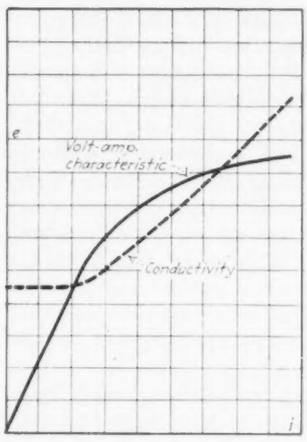
THE mechanism of breakdown of solid insulation is essentially different from that of air. Solid insulators do not have a definite dielectric strength or breakdown gradient at which they change to conductors, as in the case of air. They are really high-resistance conductors with a very high negative temperature coefficient of resistance. One characteristic of a substance having a high negative temperature coefficient resistance is its instability at constant potential above a certain critical voltage or voltage gradient. At and above this voltage the decrease of resistance by the increase of temperature increases the current density and thus the temperature indefinitely, thereby short-circuiting the constant-potential supply and destroying the insulator. Below this critical voltage the decrease of resistivity and increase of temperature limit themselves and the conditions are stable.

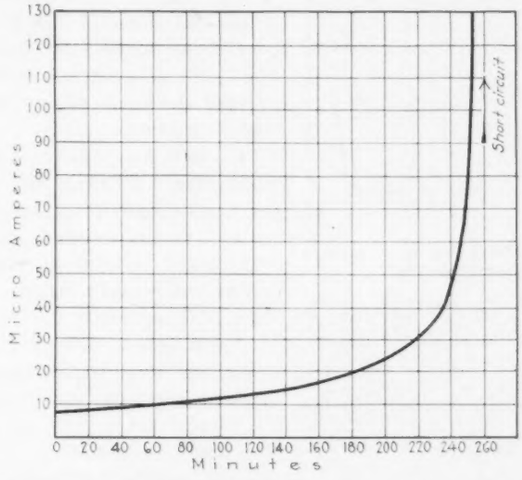
This critical voltage point is called the breakdown point or puncturing gradient. However, it is not a constant of the material like the dielectric strength of air, but depends upon the relation between heat production and heat dissipation in the insulator, and therefore upon many extraneous conditions. If the short-circuiting which occurs at breakdown under constant potential supply is avoided, the insulation can be stressed above the critical gradient without any harm.

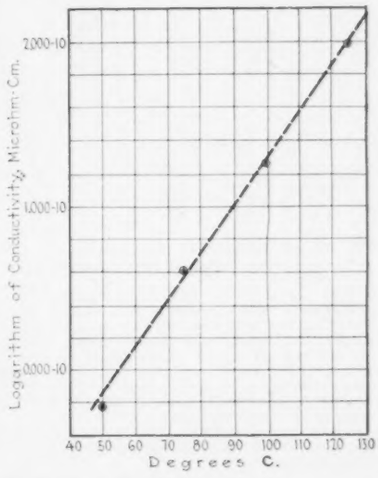
Consequently dielectric breakdown of a solid insulation is a temperature effect. It cannot take place instantaneously; some time must elapse during which the temperature at the place of breakdown reaches the critical value. Solid insulation must therefore have a time lag in breakdown, and this time lag is the shorter the more the impressed voltage gradient exceeds the critical voltage or critical gradient respectively—the so-called "puncture voltage." The time lag is of the magnitude of seconds, minutes or hours. Anything that affects the temperature affects the critical or puncture voltage of solid insulation, respectively the critical or disruptive gradient, so that the latter is not a constant of the material, but a function of the electrical and thermal circuit.

As examples of what may affect the time lag of insulator breakdown the following may be cited:

A. In an alternating dielectric field dielectric losses of the nature of hysteresis increase the heating. At the same time, heating due to the conduction current is less in the alternating field than in a direct-current field having a voltage equal to the maximum value of the alternating field. The total heating, therefore, may be more or less, depending upon the relation between dielectric losses and the conduction losses, and thus upon the frequency.







FIGS. 1, 2 AND 3—EFFECT OF CONDUCTION CURRENT, ELAPSED TIME AND TEMPERATURE ON CONDUCTIVITY OF THREE SAMPLES OF INSULATION

Fig. 1—The continuous-current voltage impressed upon the insulation was gradually increased, and current measurements were made with the necessary precautions to protect against stray and leakage currents by means of guard rings, ground shields, etc. As may be observed the current first increases proportionally to the voltage, then more than proportionally, and at an increasing rate until finally the current "ran away." That is, it increased without further increase of voltage, and puncture occurred and destroyed the insulation. The approach to puncture is indicated by a gradual and progressive increase of the conductance of the insulation. The material tested was composite high-voltage armature insulation.

Fig. 2—To obtain these data a number of layers of black varnished cloth such as are used in machine insulation were wound on a brass tube and covered with tinfoil. A unidirectional continuous voltage was impressed and kept constant at 57.6 kv., and the current passing through the insulation was read every thirty seconds. At first the current rose slowly, then increased rapidly, and finally ran away, causing breakdown more than four hours after the application of the voltage. This test shows an increase of conductance with time at constant impressed voltage. Fig. 3 refers to black varnished cloth also.

Usually the total loss, and thus the heating, in an alternating field is higher, and the critical voltage therefore lower, than in a direct-current field. However, there are some insulators of low dielectric losses and high conduction loss which break down at a direct-current voltage less than the maximum value of the alternating puncture voltage.

Consequently, the ratio of direct-current to alternating-current puncture voltage with air is $\sqrt{2} = 1.41$; with solid insulation it may depend on the frequency, and usually is higher, though it may be as low as 1.00 in the case of Fig. 3. The ratio may have to be experimentally determined for every material or class of material.

B. Comparing an insulation consisting of m layers with one consisting of n time m layers of the same material: The latter has n times the thickness and if there were a definite dielectric strength would require n times the voltage for puncture. Not so, however, with the puncture considered as a temperature effect. At moderate thicknesses of the insulation the major portion of the heat is conducted away transversely to the meta: termina s. With nm sheets the path of heat conduction is n times longer than with only m sheets, and the heat conduction thereby considerably decreased. As the puncture gradient is determined by the balance of heat production and heat dissipation, it thus follows that the puncture gradient is lowered by the decreased heat conductance: that is nm sheets puncture at a voltage materially lower than n times the voltage at which m sheets puncture. In other words, the disruptive strength of built-up material does not increase proportionally to the number of layers or thickness, but at a materially less rate.

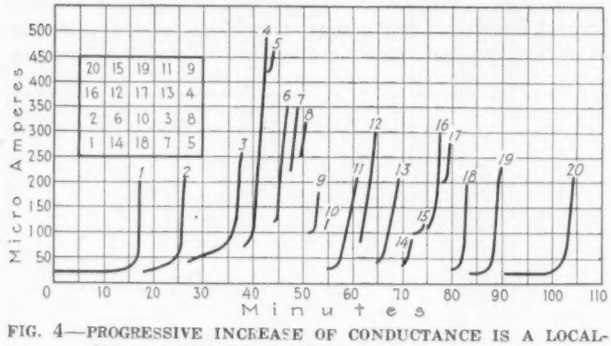


FIG. 4—PROGRESSIVE INCREASE OF CONDUCTANCE IS A LOCALIZED AND POSSIBLY SHIFTING PHENOMENON

The insulation, which consisted of twelve sheets of unimpregnated linen paper, was tested with a constant potential of 5,650 volts between metal plates having an area of 4.20 sq.cm. Then the upper electrode plate was cut into twenty sections, connected by very small fuses, and the test repeated. At first the current increased slowly, then rapidly, and finally ran away, and puncture occurred, just as in Fig. 2. But the blowing of the fuse cut off the section in which the puncture occurred, and the excessive current vanished until a weak spot developed in some of the other sections which had remained under voltage. Then the current increased, puncture resulted, and another section was cut off, etc.

C. In the insulation between concentric cylinders, as in cables, the voltage gradient increases toward the interior, and the inner layers of the insulation may thereby be stressed materially above the gradient found for the same thickness of material as its breakdown gradient in a uniform field. Nevertheless, these "overstressed" inner layers are not damaged but continue to take their share of the voltage. With air under these conditions the overstressed portion would become conducting and filled with corona.

Thus in a non-uniform field with solid insulation puncture occurs not when the maximum gradient at one point or over a finite range has exceeded the critical value, but when a dielectric circuit as a whole, between the terminals, passes the critical voltage or potential at which the temperature "runs away."

The foregoing observations and conclusions were reached as a result of extensive tests conducted with two new "tools" devised especially for the study of solid insulations over the entire voltage range before and after the so-called "breakdown" point. Methods differing from those usually employed were used because applying an alternating-current voltage between metal terminals until puncture occurs shows nothing while the potential is being raised except surface corona, perhaps, whereas after puncture the insulation is destroyed by the energy concentration. With the ordinary tests, therefore, no information is obtained but the voltage gradient at the puncture voltage. This depends greatly on time, temperature, thickness and shape of material, on the amount and nature of surrounding materials, on the heat conductivity of the insulation and the surrounding material, and even on its color and many other features.

How Observations Were Made

In the method developed especially for testing solid insulations a vacuum-tube rectifier made available constant unidirectional voltages of considerable power up to several hundred thousand volts. This permitted measuring the current passing through the insulation during the gradual voltage rise up to and beyond the breakdown point, and thereby the resistivity or conductivity. As a result characteristic conductivity changes were discovered. These are hidden in alternating-current tests by the much larger capacity current. This method also eliminated the dielectric losses and so permitted the exact determination of the energy input into the insulation.

Various methods were devised to eliminate the energy concentration in the path of puncture, so that the insulation could be studied far beyond its so-called breakdown point. Some of the observations which were made and which are typical of the remainder of the tests are graphically represented in the accompanying illustrations. They show progressive increase in conductivity under constant voltage stress and the effect of elapsed time on insulation breakdown. To determine whether this progressive increase of conductance, which leads to breakdown of the insulation, is uniform throughout the sheet of insulation or localized at a defective spot at which puncture will later occur, tests were conducted with various insulations. The results of one set of tests are shown in Fig. 4.

Current Not Uniformly Distributed

The foregoing test indicated that the gradual increase of current and of conductance which leads to puncture is not uniform throughout the insulation but occurs locally at the spot at which puncture eventually occurs. Whether there is also a gradual increase of conductivity of the entire insulation during the time of voltage application cannot be decided from these tests. If so, it is small compared with the local current rise at the point where the puncture develops.

Another pertinent conclusion follows from Fig. 4: Twelve sheets of linen paper were used, so that the coincidence of four defective spots was entirely improbable. Even if four defective spots coincided and were entirely conducting, it would still leave two-thirds of the sheets of paper, so that the current density could increase locally only 50 per cent. In the total current this would be entirely inappreciable. However, the total current increased several-fold, which proves that the defective spot in the insulation involves all the layers, even the perfect ones.

The explanation of breakdown of build-up insulations, therefore, cannot be that the failure of the defective layers increases the gradient on the other and unde-

fective layers beyond their disruptive strength, thereby breaking them down. The breakdown must be pictured as a deterioration proceeding from a defective spot in one or a few layers and gradually penetrating and damaging the other undefective layers until the whole thickness is deteriorated. The mechanism may consist in the concentration of the voltage gradient at and by the defective spot. For example, a partially conducting spot in one layer of the insulation might cause an electrostatic cutting edge which would penetrate the other layers and thereby produce a conducting path.

Often in such tests as described the increase of current before the breakdown is smaller than shown in Figs. 2 and 4, and sometimes it is hardly appreciable in the total current. Nevertheless, the local current density, and thus the conductivity, may have increased many hundredfold. For instance, in the first breakdown (Fig. 4) the conductivity of the deteriorating spot had increased a hundred-thousandfold, assuming the area of the deteriorating spot as 4 sq.mm. out of a total plate surface of 420 sq.cm.

What is the significance of this increase of conductivity? This may be answered by considering Fig. 3, which shows the temperature conductivity characteristic of black varnished cloth. As may be observed, the conductivity increases or the resistivity decreases about tenfold with every 35 deg. C., indicating that the material has a very high negative temperature coefficient of resistance. This action is typical of all solid insulating materials, at least as far as they are known.

Now, suppose that a sheet of insulation of uniform thickness is subjected to a uniform dielectric field. A leakage current or conduction current passes through this insulation. If the insulation were perfectly uniform, this current would have uniform current density and give a uniform temperature rise of the insulation by its power dissipation (ei). As the material cannot be perfectly uniform, the current density and the heating caused by it would not be perfectly uniform. At low voltage, where the temperature rise is very small, the temperature difference within the sheet due to the differences of current density would be so small that the conductivity would be practically uniform and the conditions stable.

If, however, the voltage is gradually raised and the leakage current and temperature thereby augumented, the conductivity, current density and power input to the sheet will in turn be increased, particularly at some one spot which will be the ultimate puncture point. As a result the temperature would rise, and this would still further increase the conductivity. This increases the power and thus the temperature. Unless some compensating influence such as heat radiation equal to increased heat generation comes into play the temperature and current density will run away, destroying the insulation by heat or puncture, as shown in Figs. 2 and 4.

Thermal Condition a Vital Influence

The "disruptive voltage," then, is a voltage at which the increase of conductivity and temperature cease to limit themselves at some local spot. This point depends on the heat locally produced (that is, the voltage and conductivity), and the heat carried away (that is, the heat conduction, convection, storage, etc.) thus depends on the shape of the structure, etc. Therefore, the disruptive voltage is not a definite characteristic of the material, and the breakdown value of the insulation is that at which the temperature-voltage characteristic becomes unstable.

Neither is the breakdown gradient a characteristic of the material alone. It, too, depends on the condition of operation, more particularly the relation of the heat production to the heat dissipation. Under one condition, an insulation may be operated without breakdown point at a gradient which would be far above the breakdown gradient under other conditions. It follows that the insulation is not damaged or destroyed by straining it above the breakdown gradient and that nothing particular occurs at the breakdown gradient. Hence the so-called breakdown gradient is a characteristic of the electrical and thermal circuit. Straining solid insulation to and beyond the breakdown gradient will not necessarily damage it. When damage or destruction

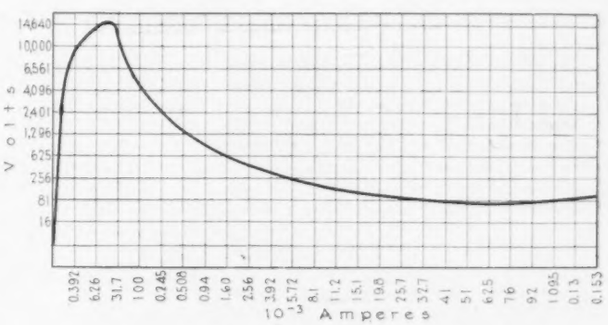


FIG. 5—VOLT-AMPERE CHARACTERISTIC OF NERNST LAMP GLOWER

As may be observed from the characteristic of the Nernst lamp glower, the current increases with increasing voltage, first proportionally to the voltage, then more rapidly (with increasing rapidity), until at about 16,000 volts the current "runs away" and the insulator "breaks down"; in other words, the current indefinitely increases without further increase of voltage. At a constant voltage supply the insulator is destroyed by the current short-circuiting. If, however, the current is limited and gradually increased, the voltage decreases again and gradually comes down to less than 1 per cent of the breakdown voltage. The current may become many times larger than the current at the breakdown point without the insulator being destroyed.

does occur, it is due to the excessive energy concentration incident to constant potential supply.

Thus it becomes possible to study the behavior of solid insulation beyond the "breakdown gradient" by limiting the energy concentration, thus observing the insulation, not under constant potential, but under constant current supply. This makes it possible to carry the volt-ampere characteristic of the insulation far beyond the breakdown point and back, without damage to the insulation. [A characteristic similar to that of insulation is exhibited by the electric arc. The arc is unstable at constant potential; that is, the current runs away and short-circuits, and stability is produced by using a sufficiently high series resistance.]

In insulation testing, a series resistance, no matter how high, will not usually limit the current at the spot where, by a local temperature rise, the insulator passes the breakdown gradient, because with the increase of current at this spot the voltage decreases. However, this spot is a small part of the total sheet of insulation, and its current therefore a small part of the total current. A drop of voltage reduces the conduction current through the entire insulation and so makes it available at the critical spot. At this spot the current density may increase many hundredfold and thus destroy the insulation without increasing the total current and

BEHAVIOR OF AIR UNDER DIELECTRIC STRESS IS DIFFERENT FROM THAT OF SOLID INSULATIONS (PEEK, WHITEHEAD AND OTHERS)

(1) Air has a definite *dielectric strength* g_o. This is proportional to the air density and is 30 kv./cm. at 0 deg. C. and 76 cm. barometer.

(2) Air breaks down and becomes conducting when the dielectric gradient g exceeds the dielectric strength g_o over a definite distance, the so-called *energy distance.* This energy distance depends on the shape of the dielectric field.

(3) The maximum gradient g_m therefore must be so large that the breakdown gradient g_o is exceeded over the entire energy distance.

Between spheres of radius r the maximum gradient is at the surface of the spheres, and is:

$$g_m = g_o\delta\left(1 + \frac{0.54}{\sqrt{\delta r}}\right)$$

and between cylinders of radius r:

$$g_m = g_o\delta\left(1 + \frac{0.30}{\sqrt{\delta r}}\right)$$

where δ = air density, referred to 0 deg. C. and 76 cm. barometer.

(4) When the gradient exceeds the dielectric strength g_o over a space equal to or greater than the energy distance, the air breaks down in this space and becomes conducting. If thereby the gradient in the remaining part of the field is not increased, breakdown limits itself and corona takes place in the broken down part of the field. If, however, the gradient is increased in the remaining part of the field, the breakdown progresses until either spark discharge occurs between the terminals, or the gradient does not further increase and the corona limits itself.

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therefore without being limited by the series resistance, because the current through the other part of the insulation correspondingly decreases by the voltage drop. About the same condition exists as if an arc were shunted by a very low resistance. It would then be unstable, even in a constant-current circuit, because the current in the arc could increase without the total current increasing, owing to the current in the shunting resistance decreasing by reason of the decrease in potential drop.

To carry the study of insulation beyond the breakdown point either requires the testing of a piece of insulation so small in section that the temperature throughout the section remains uniform or it requires a local current limitation so that at every point of the insulation the local current density is limited. The latter can be accomplished by placing in series with the insulation another insulation in which the conductivity does not appreciably change within the temperature range in which the first insulation breaks down. For instance, mica is placed in series with black varnished cloth, and then the voltage drop across the mica is segregated from that in the insulator under test, namely, the black varnished cloth.

Using a small section of insulation (a fraction of a square millimeter) is feasible only with insulators which have relatively a very high conductivity, so that the conduction current through the small section is measurable by a sensitive galvanometer. Within this limitation it is the most convenient way. Such insulation is available in the material of the Nernst lamp glower. This affords a convenient means of observing the entire volt-ampere characteristics of an insulator. (See Fig. 5.)

To bring the different parts of the curve within visible range on the same sheet, the fourth roots of e and i are used as co-ordinates in Fig. 1, instead of their first powers. The ratio of the currents at constant conductance, at the breakdown point or maximum voltage point and at the minimum voltage point is of the magnitude 1:6,000:20,0000,000.

From the volt-ampere characteristic of Fig. 1 a temperature conductivity characteristic like Fig. 3 can be calculated. Conversely, from the temperature conductivity characteristic (Fig. 3) a volt-ampere characteristic can be calculated which has the same character as Fig. 1. As may be observed, the breakdown point in current and voltage is not a constant of the material, but can be varied over a wide range by changing the relation between heat production and heat dissipation; this can be done by varying the ambient temperature.

In concluding, the authors wish to say that the experimental investigations made abroad by Dr. Wagner have led him to practically the same conceptions as those outlined above. While it would be premature to claim that all breakdowns of solid insulations are temperature effects, it has been found that this conception is corroborated over a wide range of insulating materials, as is shown by the illustrations.

The New 105,000-Kw. Generating Station at Birmingham, England

THE new electric station at Nechells, Birmingham, England, of which a view was given in the *Electrical World* for July 29, page 240, has been under construction for nearly ten years. Work upon it was interrupted during the war, but the plant is now virtually completed at a cost of about £1,000,000. The site is near large filter beds which furnish an ample supply of water for condensing purposes. The plant is constructed on reinforced-concrete piles, and the condensing-water reservoir and canal basin are built of the same material. The buildings are of steel with a brick shell. There is coal storage for 80,000 tons, and it is estimated that fuel consumption will amount to 300,000 tons a year.

The completed boiler house will accommodate forty-five boilers. Each section of the house contains six marine-type water-tube boilers, fitted with superheaters, economizers and chain-grate stokers. Each boiler is capable of evaporating 42,000 lb. of water per hour. The turbine house at present contains two 15,000-kw. turbo-alternator sets, each having its own condensing plant, and the completed turbine house will ultimately contain seven such sets, giving a total capacity of 105,000 kw. The operating floor of this house is 23 ft. above the basement, and large open walls are left, in which are installed the condenser pumps and other apparatus. The alternators generate current at 5,500 volts, which is distributed at this pressure to a large section of the city, two 33,000-volt lines running to substations in other parts of Birmingham.

It is believed, says United States Consul John F. Jewell, from whose report this description of the new station is taken, that the plant will have a material effect in reducing the cost of production of electric power in the Birmingham district during the coming year. With cheaper production should come cheaper cost per unit of power, an increased use of electricity, and a diminution in the use of gas, which has heretofore been widely employed for domestic and commercial purposes. All plans for further development are being shaped with a view to co-ordination with the great system of superstations which is being worked out for the whole country.

A New Trend in Our Commercial Thinking

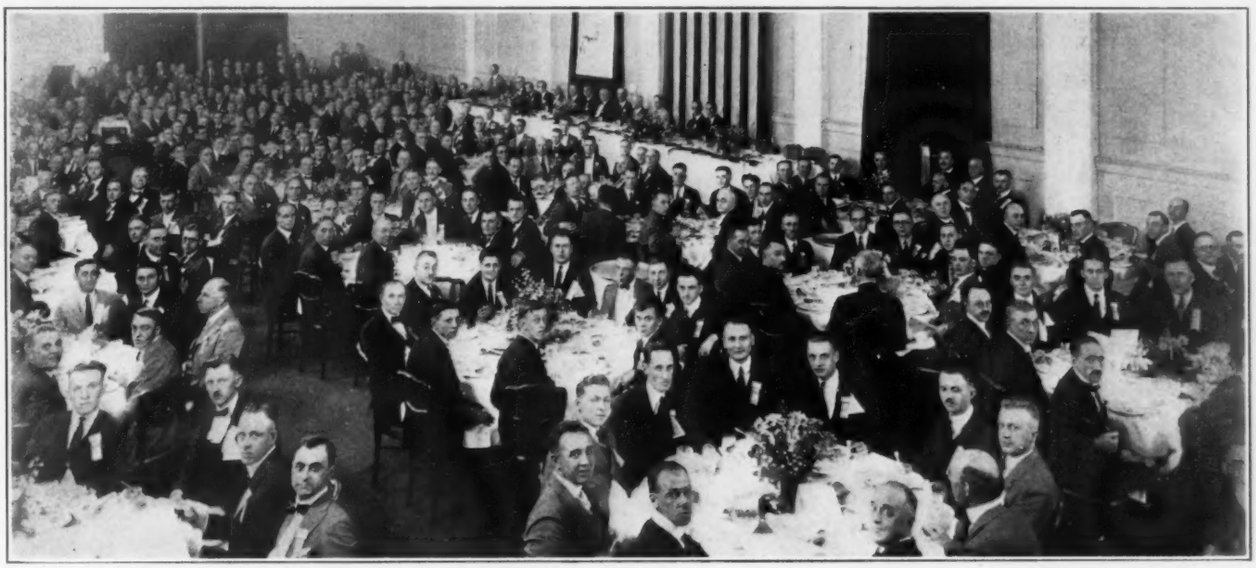
A Little Picture and Interpretation of the Recent Conference of Local Electrical Leagues and the Western New York State Conference and Other Straws that Show the Wind

By EARL E. WHITEHORNE
Commercial Editor Electrical World

THERE seems to be substantial evidence that a distinct trend in commercial thinking is developing among electrical men. The industry has come up through its forty years of rapid evolution. It has worked out of its eras of research, invention and engineering and into its commercial era. Research will continue, invention will proceed apace with progress, engineering problems and achievements will grow steadily greater as the industry expands. But we have passed on beyond the day when every kilowatt ground out found an eager waiting market. We have skimmed off the business that lay like thick, sweet cream upon the surface. We have recognized at last the fundamental need for systematic market development through creative selling. And we are apparently beginning to realize that this selling must be done, not nationally and in great campaigns but locally in towns and cities, everywhere, by continuous, consistent cooperation among the electrical men who live and work there. And if this idea takes hold throughout the industry, it is going to bring some mighty changes in our world of electricity.

I have just come from two very unusual meetings of electrical men. They have impressed me tremendously with the feeling that a new vision is breaking out and a new purpose forming in the industry. They were the conference of local electrical leagues held at Association Island and the Western New York State Electrical Conference at Buffalo. Out of them have converged a lot of impulses and indications that seem to me to carry a meaning and a message which I should like to picture and interpret if I can.

These two meetings may logically be considered direct outgrowths of the general movement for business development which was initiated by the National Electric Light Association and has been under the direction of the Joint Committee on Business Development. The job of developing local co-operative leagues and serving them was put up to the Society for Electrical Development. The society called a conference of existing leagues, and representatives of twenty leagues and fifteen other cities where leagues are in process of organization came to the island and spent three days discussing, in a word, what leagues have done, what leagues can do.



THE SIX HUNDRED ELECTRICAL MEN OF WESTERN NEW YORK STATE WHO HELD A CONFERENCE ON COMMERCIAL PLANS IN BUFFALO

For the first time in all these years, men of the cities —not just jobbers, manufacturers, central-station executives and contractors, but men of the cities speaking and thinking for the electrical families of those communities—were gathered together to talk, not about merchandising, wiring, light and power, jobbing or manufacturing, but about promoting electricity in cities. And they were national in their scope and point of view, for these men were from Los Angeles, San Francisco, Boise, Salt Lake City, Denver, St. Louis, Chicago, Toledo, Cincinnati, Pittsburgh, Cleveland, Buffalo, Philadelphia, New York, Boston and other places in between.

I have sat in on many electrical meetings in the last sixteen years, but here was a new line of talk—all kinds of electrical men from all kinds of places focused on one

common purpose and an absolutely fundamental one. They were there to try to find new ways to make electrical men, co-operating in their individual towns, individually more prosperous and to try to influence more towns to organize leagues and do the same thing. There were 125 delegates in camp. They played together, they talked together, they ate together, they sang together, they met together in working sessions under the big elm or over the boathouse and got acquainted and helped each other as men can on "the Island." Camp clothes, soft shirts, open at the throat without neckties, white caps all alike with each man's name in front, the row of tents, the broad parade ground, the lake, the boats, the ducks and swans, the bugle calls, the band playing, the free and friendly comfort and informality of the atmosphere brings men's minds together and gets things started.

I am not going to tell about the meetings. W. W. Freeman was there. E. W. Rockafellow was there. W. F. Robertson was there, and E. W. Lloyd, and Walter Neumuller, and F. M. Feiker, and W. L. Goodwin, and a lot more men who have worked long and earnestly to build this industry. And they all talked, and the men from all the leagues talked, and out of it came a picture of what co-operative electrical organizations have done in different cities and what things they can and ought to do. Under the leadership of different chairmen the story of the leagues was drawn out and certain basic facts were clearly pictured. For instance, there are six different activities in which local electrical leagues have profitably engaged and can profitably engage. And there are at least eleven very definite problems of policy which all leagues must face on organization and should settle with a full knowledge of contemporary experience.

Scope of League Work

The opportunities for useful service to the local electrical family lie along the lines of (1) social activities, such as electrical club rooms, luncheons and meetings, where addresses are made on helpful subjects; (2) coordinated publicity, such as co-operative electrical pages in the newspapers and other advertising; (3) co-operative educational demonstrations and exhibitions, such as electric homes and electric shows; (4) advisory service to home builders and architects, to assist in laying out wiring plans and in raising the standards of electrical equipment; (5) co-operative demonstrations and service in the specific promotion of residence, commercial or industrial illumination, electric power, or vehicles or any other application, and (6) work for harmony among local electrical men, assisting in the adjustment of disputes and the development of closer co-operation and better understanding.

It developed that different leagues in different cities have begun their work in different ways. Some start as lunch clubs, some by organizing co-operative pages in the newspapers, some with a "home electric" or a show. Some devote most of their attention to harmony work. Local conditions have directed their steps. Most of the leagues are only doing two or three things, but it is agreed that all of them could work along all six of these lines and that such co-operative effort could be organized in every city to the great advancement of the industry and the great profit of the local men.

But there are problems to be faced and carried through: (1) Should there be a permanent headquarters? (2) Should a paid secretary be employed? (3) How heavy should the dues be? (4) What kind of speakers should be featured at meetings? (5) How should the expense of league activities be apportioned among the different classes of electrical men? (6) What should be done when the central-station company is unprogressive in lamp policy and merchandising methods? (7) How about non-electric store competition? (8) When there are two antagonistic associations in a town, what should be done? (9) How can bad union conditions be improved? (10) How can the outlying suburban communities be tied into co-operative work?

These questions were all raised at the meetings and discussed. It was shown that some leagues have impoverished themselves with too heavy headquarters expense, and some have failed to function because of lack of organization. Some cities were seen to be practically deadlocked because two groups are contending for leadership. In other towns fine work is being done and far-reaching progress made because their policies are right.

I won't attempt to give the answers here. The abstracted minutes of the conference will be soon published by the society and will tell the story. Enough to say that these men went away pledged to active help in the development of the best possible plan for organizing and financing a local league, and the society was indorsed as the headquarters for league activity to carry on the work of developing more leagues and serving them. Every man present—contractor, dealer, jobber and manufacturer—agreed that the further upbuilding of the electrical industry must rest on the work of local men in the towns and cities and that the central station occupies a naturally dominant position and must give generous leadership and co-operation if local development is to measure up to the waiting opportunity in any creditable degree.

The Buffalo Meeting

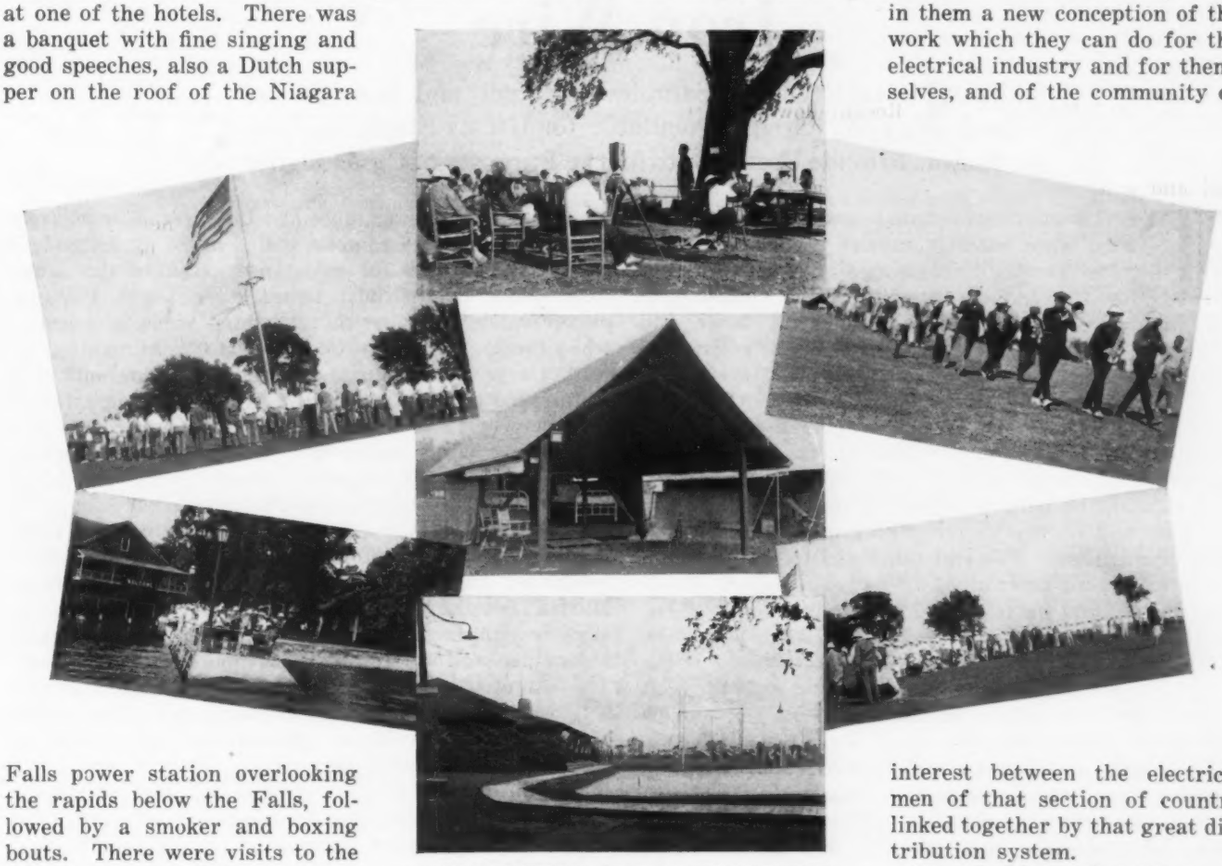
So much for the league meeting. These were men come from the towns where they are working to talk about what to do. In Buffalo the industry has just seen the other side of the picture—the most encouraging practical demonstration of how to do it in a big way that has ever been recorded, I believe. For to bring this message home to the electrical men of western New York State and crystallize this opportunity through the great section served by hydro-electric power from Niagara Falls, more than six hundred dealers, contractors, central-station men, jobbers and manufacturers from nearly one hundred communities were in session for two days, trying to get a clearer plan of how to build up business now in western New York.

W. F. Robertson of the Robertson-Cataract Electric Company fathered the project by inviting eighteen men to take lunch with him one day. They all came. They represented these organizations: Niagara Falls Power Company, Buffalo General Electric Company, Niagara, Lockport & Ontario Power Company, Tonawanda Power Company, Niagara Electric Service Corporation, General Electric Company, Westinghouse Electric & Manufacturing Company, Western Electric Company, McCarthy Brothers & Ford, H. I. Sackett Electric Company, Lloyd A. Wooley, Inc., and the Electric Club of Buffalo.

He outlined to them his idea of bringing all the elec-

trical men of western New York State together to meet each other and receive a clear picture of the immediate business opportunity and how to develop it. He suggested a two-day conference and ten thousand dollars to finance it. The plans were formed and the money was pledged right there at the luncheon. The power companies and the transmission company recognized that if the local electrical men of the various communities to which their power flows can be helped to a fuller prosperity, they will benefit with them. The Buffalo jobbers and manufacturers realized that their own market would be increased likewise. They were willing to spend the money. So the invitations went out and everybody came to the party.

Meetings were held two mornings and one afternoon at one of the hotels. There was a banquet with fine singing and good speeches, also a Dutch supper on the roof of the Niagara Falls power station overlooking the rapids below the Falls, followed by a smoker and boxing bouts. There were visits to the Buffalo General Electric steam station and an inspection of the great 36-ft. hydraulic tunnel now nearing completion through solid rock under the city, to lead water to the new station. Everything was paid for by the hosts except your room and your breakfast. Everybody had a good time and showed it.



THESE SNAPSHOTS FROM THE CONFERENCE OF LOCAL ELECTRICAL LEAGUES TAKEN AT ASSOCIATION ISLAND SHOW SOMETHING OF THE NATURE OF THE PARTY

But it was the meetings that impressed you most. During most of the first session more than a hundred men stood silently at the back of the hall. The crowd stuck to the end of each meeting, interested and attentive. The number of new faces was striking to any one who has been about to electrical conventions a good deal. They were for the most part men of small towns who have small organizations and are busy at home and do not go to meetings. They were not conference-weary. They were eager to get advice and new ideas.

The program was well thought out. It opened with a picture of the present and future market. Then three men of three financing companies told how the local man can arrange the financing of wiring and appliance sales on deferred payments. Then two men talked on advertising. Then there were two talks on wiring with a two-act play that told the story of the value of adequate wiring and how the contractor can sell it. Then came talks and demonstrations that covered industrial power, presented by five men, appliances, discussed by three men, and lighting, about which three men talked.

The plan was to picture to these men of western New York the fullness of the opportunity in their own towns. Piece upon piece this picture was put together by men who stand before the industry as knowing these subjects and in position to give counsel. There was implanted in them a new conception of the work which they can do for the electrical industry and for themselves, and of the community of interest between the electrical men of that section of country linked together by that great distribution system.

How do I know that this is so? Well, the Robertson-Cataract company held a conference of its salesmen on the day after, to line up its organization, and sent the men out into the field to see what the result had been and how they could individually serve in putting the idea into action locally. They report throughout the section a keen purpose to go forward and develop business in every direction *now*, and a very large number of letters have come back to Buffalo saying, "Don't worry about the value of the conference. It is going to pay us all, because we are going to work to make it pay here in this town and so in other places." And many men have said that this western New York State group must get together periodically and plan its work.

From the league conference up on Association Island has come the same reaction. Already several cities have sent word that they are organizing leagues, or

clubs or electrical boards of trade, for co-operative development work.

It shows, I believe, a new trend of commercial thinking among electrical men. We are beginning to come down to earth and realize that we cannot develop our industry by sending up balloons and shooting rockets and flying flags in national campaigns full of fine plans for what somebody else should do.

What we need is work, steady, persistent, creative, harmonious work, at home by the men of every town, that we may wire more houses and sell more motors and more good lighting and more appliances. For it is in the individual homes, stores, offices and factories along the individual streets of individual towns that the separate sales must be made and the separate jobs done out of which electrical development must be built up. And all this work must be done not by national associations or committees, but by all kinds of electrical men working singly and in co-operating groups in these communities.

Electrical Characteristics of Steel and Iron Wire

Tests Conducted on Samples of Steel and Iron Strand and Wire Which Are Available for Use as Electrical Conductors Provide Useful Data for the Purposes of the Designer

TESTS on steel strand and galvanized-iron wire were recently carried out at the Electrical Testing Laboratories of New York City for the Indiana Steel & Wire Company to determine (a) the continuous-current resistance and resistivity, (b) the temperature co-efficient of resistance, (c) the alternating-current resistance at 25 cycles and 60 cycles, and (d) the alternating-current inductance at 25 and 60 cycles. A considerable portion of the data obtained follows here.* The alternating-current measurements were made by a Wheatstone bridge method, with the wire suspended in the air in the form of a long and narrow rectangular loop of constant and known dimensions. The resistance and total inductance of the loop were determined in terms of known standard resistors and inductors. The average length of the test loops was approximately 115 ft. (35 m.) and the width 30 in. (75 cm.). The loop was broken in the center for the introduction of test current, and the ends of the wire were dipped in mercury pools for connection to the bridge network.

The results of the tests are given in Table II, which contains the true direct-current resistance, effective alternating-current resistance, skin-effect resistance ratio, internal inductance ratio at unit permeability, effective internal inductance and the internal inductance ratio for all of the samples tested at 25 cycles and 60 cycles. Each value of resistance given in the tables corresponds to the final temperature which the conductor would reach, with the stated value of current, when the air temperature is 20 deg. C. In making the tests the various values of alternating current were maintained until the resistance of the loop had attained final value. Table I, which gives the temperature rise of various wires above air temperature in degrees Centigrade, shows opposite characteristics in ¼-in. Siemens-Martin and No. 6 B.W.G. wire.

Comparison between three different grades of ⅜-in. strand (9.5-mm.) is afforded by Fig. 1. The skin-effect resistance ratios in the high-strength and Siemens-Martin strand are of a nominal order and increase but slightly with the current density. (Fig. 2.) The internal-inductance ratios are of relatively small magnitude. The samples evidently had the low magnetic permeability characteristic of medium-hard steel. The sample of standard grade shows pronounced skin effect increasing rapidly with increase of current and much higher internal-inductance ratios, indicating considerably softer steel than the other two samples. Owing to the differences it becomes a question in any specific case which grade of steel should be selected to obtain the smallest permissible conductor from the electrical standpoint. Fig. 1, comparing the actual effective re-

*These data are abstracted from a report made by Frank F. Fowle, consulting engineer of Chicago, and copyrighted by the Indiana Steel & Wire Company.

TABLE I—TEMPERATURE RISE (DEG. C.) OF VARIOUS SAMPLES ABOVE AIR TEMPERATURE AT DIFFERENT CURRENTS

	Total Circ. mils in Conductor	Ratio of Resistivity to International Annealed Copper Standard (Per Cent)	Ratio of Conductivity to International Annealed Copper Standard (Per Cent)	Resistance Temp. Coefficient per Deg. C from and at 20 Deg. C.	Current Density at 10 Amperes (Amp. per sq.in.)	Test Frequency	Current in Amperes 5	10	15	20	25
⅜-in. high-strength strand	99,960	10.34	9.67	0.00338	127.4	60	0.2	0.6	1.8	3.0	4.6
						25	0.2	0.8	1.6	...	...
¼-in. Siemens-Martin strand	177,600	10.87	9.20	0.00333	71.67	60	0.2	0.8	1.2	1.8	2.8
						25	0.2	0.8	1.2	1.8	3.0
⅜-in. Siemens-Martin strand	99,960	10.03	9.97	0.00348	127.4	60	0.4	1.4	2.4	4.6	6.6
						25	0.4	1.6	3.0	4.4	6.4
¼-in. Siemens-Martin strand	46,900	10.41	9.61	0.00309	271.5	60	0.6	2.8	5.4	11.8	17.8
						25	0.6	3.2	7.4	12.6	18.2
¼-in. standard strand	109,400	6.73	14.85	0.00570	116.4	60	0.2	1.0	2.0	2.6	5.0
						25	0.2	1.2	2.0	3.0	5.6
3-ply No. 8 B.W.G. twisted guy wire	78,930	7.66	13.05	0.00445	161.3	60	0.2	1.0	2.6	5.8	9.2
						25	0.2	1.0	3.6	5.4	8.6
No. 6 B.W.G. "BB" telephone and telegraph wire	40,800	6.59	15.18	0.00496	312.0	60	0.2	2.8	7.4	13.2	22.8
						25	0.2	2.6	6.6	10.6	18.4

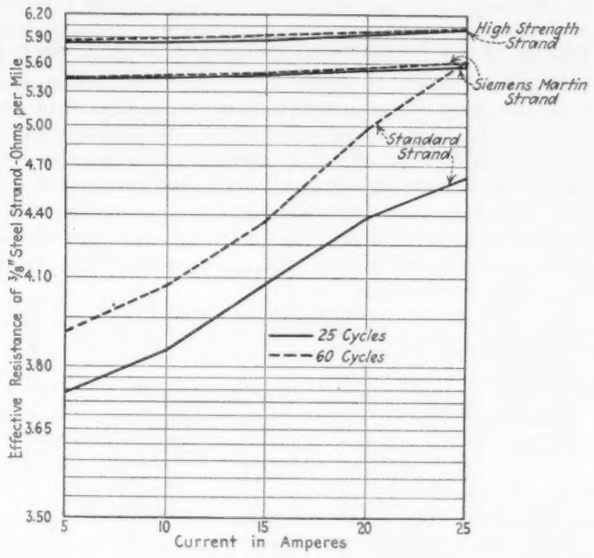


FIG. 1—EFFECTIVE RESISTANCE OF THREE SAMPLES OF IRON WIRE AT 5 AMP. TO 25 AMP.

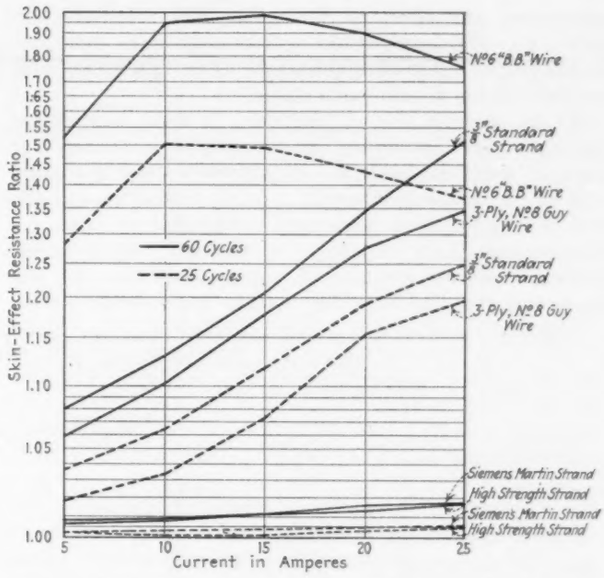
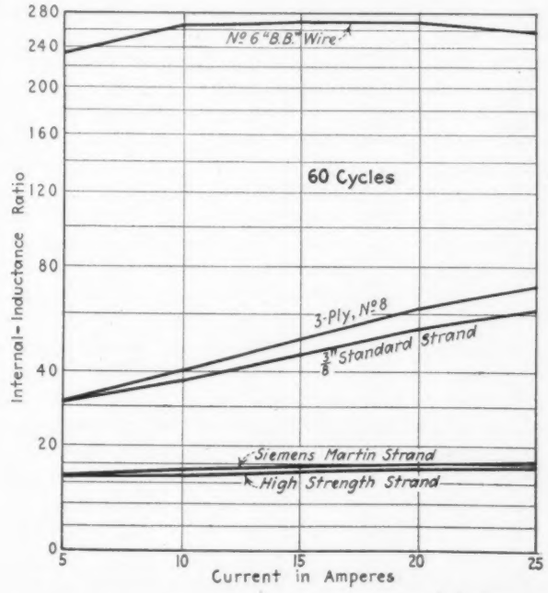


FIG. 2—SKIN-EFFECT RESISTANCE RATIOS OF SEVERAL SAMPLES OF IRON WIRE AT DIFFERENT CURRENT DENSITIES

sistances of the samples, makes this clearer. From this graph it appears that the standard sample has a lower effective alternating-current resistance at 60 cycles up to 25 amp., but for larger currents it is probable that the Siemens-Martin sample would have the lower resistance. At 25 cycles the standard sample shows a lower resistance in every case, although there seems to be a tendency to approach the same resistance at some larger value of current. In every case the internal reactance of the standard sample is several times larger than that of the other two.

The comparisons set up in Fig. 2 show certain characteristic differences, noticeable particularly in the case of BB wire. The skin-effect resistance ratio, making allowance for differences in density at equal values of current, and the internal-inductance ratios are least in the guy wire and maximum in the BB wire, indicating that the degree of hardness is greatest in the guy wire and least in the BB, with the standard strand intermediate. An effect noted only in the BB wire is the decrease of skin-effect resistance ratio and internal-inductance ratio after current values exceed approximately 15 amp. While there might be some question in a particular case whether guy wire or standard strand would be the better, it seems evident that both are superior to BB wire. By applying skin-effect resistance factors to the values of volume resistivity, it seems that BB wire is inferior to Siemens-Martin steel at 60 cycles with equal current densities. At 25 cycles the reverse is probably true.

While no specific investigation of wave distortion was made, it is proper to point out that such distortion will always occur in some degree with iron and steel conductors, being most pronounced with wires of high permeability. All tests were made under conditions



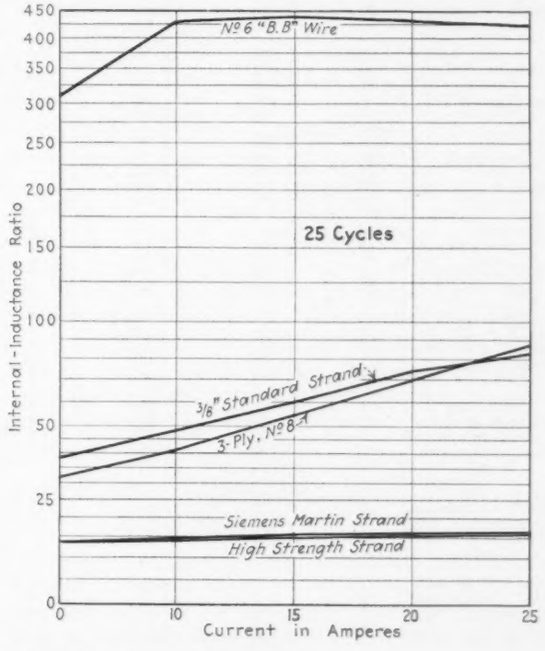


FIG. 3—INTERNAL-INDUCTANCE RATIOS OF FIVE GRADES OF STEEL STRAND

precluding any effect of harmonics that might be circulating in the loops on the test results. The measurements with alternating current were all made with current having a sine-wave shape.

As to possible use of the data it may be pointed out that steel conductors can be used to advantage for lines of short or moderate length where the minimum size of conductor is fixed by corona discharge and the line resistance is a secondary consideration, and for high-tension lines of short or medium length transmitting moderate amounts of energy, such that the line drop and the line loss fall within permissible limits, as, for example, in the case of branch or tap lines of high-tension networks. Other uses are for short lines delivering small amounts of energy at the primary voltages customary in urban and rural distribution, such that the drop and the loss are not excessive, and for long or unusually severe spans requiring greater tensile strength and factor of safety than can be obtained with copper or aluminum. In selecting steel conductors for alternating-current transmission or distribution lines the choice of the harder grades of material will insure minimum skin effect and internal reactance and maximum tensile strength.

TABLE II—SOME ELECTRICAL CHARACTERISTICS OF FIVE TYPES OF STEEL WIRE

Kind of Strand and Frequency	Current (Amp.)	True (D.-C.) Resistance (Ohms per 1,000 Ft.)	Effective (A.-C. Resistance)		Skin Effect Resistance Ratio	True Internal Inductance at Unit Permeability in Millihenries per 1,000 Ft.	Effective Internal Inductance		Internal Inductance Ratio
			Ohms per 1,000 Ft.	Ohms per Mile			Millihenries per 1,000 Ft.	Millihenries per Mile	
⅜-in. high-strength steel (single-conductor), 60 cycles	5	1.106	1.112	5.871	1.006	0.01956	0.2565	1.354	13.11
	10	1.106	1.116	5.892	1.007	0.01956	0.2690	1.420	13.75
	15	1.112	1.124	5.935	1.011	0.01956	0.2795	1.476	14.29
	20	1.118	1.132	5.977	1.013	0.01956	0.2920	1.542	14.91
	25	1.124	1.142	6.030	1.016	0.01956	0.3050	1.610	15.59
⅜-in. high-strength steel (single-conductor), 25 cycles	5	1.102	1.105	5.834	1.002	0.01956	0.2580	1.362	13.19
	10	1.105	1.106	5.840	1.001	0.01956	0.2700	1.426	13.80
	15	1.109	1.110	5.861	1.001	0.01956	0.2830	1.494	14.47
	20	1.121	1.124	5.935	1.003	0.01956	0.2960	1.563	15.13
	25	1.129	1.135	5.993	1.005	0.01956	0.3115	1.645	15.92
½-in. Siemens-Martin steel (single-conductor), 60 cycles	5	0.637	0.644	3.400	1.012	0.01956	0.2690	1.420	13.75
	10	0.639	0.648	3.421	1.014	0.01956	0.2805	1.481	14.34
	15	0.640	0.649	3.427	1.015	0.01956	0.2880	1.521	14.72
	20	0.644	0.652	3.443	1.019	0.01956	0.2960	1.563	15.13
	25	0.644	0.658	3.474	1.021	0.01956	0.3085	1.629	15.77
½-in. Siemens-Martin steel (single-conductor), 25 cycles	5	0.636	0.639	3.374	1.004	0.01956	0.2785	1.470	14.24
	10	0.637	0.640	3.379	1.005	0.01956	0.2830	1.494	14.47
	15	0.639	0.642	3.390	1.006	0.01956	0.2940	1.552	15.03
	20	0.640	0.644	3.400	1.007	0.01956	0.3035	1.602	15.51
	25	0.642	0.646	3.411	1.007	0.01956	0.3140	1.658	16.05
⅝-in. Siemens-Martin steel (single-conductor), 60 cycles	5	1.022	1.031	5.444	1.008	0.01956	0.2650	1.399	13.55
	10	1.025	1.035	5.465	1.009	0.01956	0.2820	1.489	14.41
	15	1.030	1.040	5.491	1.011	0.01956	0.2985	1.576	15.26
	20	1.035	1.051	5.549	1.016	0.01956	0.3130	1.653	16.00
	25	1.046	1.065	5.623	1.017	0.01956	0.3270	1.727	16.71
⅝-in. Siemens-Martin steel (single-conductor), 25 cycles	5	1.024	1.027	5.423	1.002	0.01956	0.2645	1.397	13.52
	10	1.027	1.029	5.433	1.003	0.01956	0.2840	1.500	14.52
	15	1.033	1.036	5.470	1.004	0.01956	0.3000	1.584	15.33
	20	1.039	1.044	5.512	1.005	0.01956	0.3150	1.663	16.10
	25	1.048	1.054	5.565	1.006	0.01956	0.3280	1.732	16.77
¼-in. Siemens-Martin steel (single-conductor), 60 cycles	5	2.315	2.320	12.25	1.002	0.01956	0.2765	1.460	14.13
	10	2.335	2.345	12.38	1.003	0.01956	0.2895	1.529	14.80
	15	2.360	2.375	12.54	1.006	0.01956	0.3120	1.647	15.95
	20	2.400	2.415	12.75	1.008	0.01956	0.3260	1.721	16.66
	25	2.445	2.470	13.04	1.009	0.01956	0.3505	1.851	17.92
¼-in. Siemens-Martin steel (single-conductor), 25 cycles	5	2.305	2.310	12.20	1.001	0.01956	0.2780	1.468	14.21
	10	2.330	2.330	12.30	1.001	0.01956	0.2920	1.542	14.92
	15	2.365	2.370	12.51	1.002	0.01956	0.3115	1.645	15.92
	20	2.405	2.410	12.72	1.003	0.01956	0.3280	1.732	16.77
	25	2.450	2.465	13.02	1.006	0.01956	0.3560	1.880	18.20
⅜-in. standard steel (single-conductor), 60 cycles	5	0.686	0.741	3.912	1.080	0.01956	0.614	3.242	31.38
	10	0.686	0.771	4.071	1.130	0.01956	0.743	3.923	37.98
	15	0.686	0.827	4.367	1.207	0.01956	0.889	4.694	45.44
	20	0.696	0.943	4.979	1.346	0.01956	1.067	5.634	54.52
	25	0.707	1.067	5.634	1.512	0.01956	1.198	6.325	61.34
⅜-in. standard steel (single-conductor), 25 cycles	5	0.681	0.707	3.733	1.036	0.01956	0.738	3.897	37.72
	10	0.684	0.728	3.844	1.064	0.01956	0.932	4.921	47.64
	15	0.690	0.771	4.071	1.117	0.01956	1.172	6.188	59.90
	20	0.698	0.830	4.382	1.191	0.01956	1.433	7.566	73.25
	25	0.700	0.875	4.620	1.250	0.01956	1.618	8.543	82.70
Three-ply No. 8 B. W. G. twisted guy wire (single-conductor), 60 cycles	5	1.026	1.086	5.734	1.059	0.02371	0.751	3.965	31.67
	10	1.030	1.134	5.987	1.102	0.02371	0.951	5.020	40.11
	15	1.036	1.217	6.426	1.179	0.02371	1.198	6.325	50.52
	20	1.052	1.343	7.091	1.275	0.02371	1.476	7.793	62.25
	25	1.067	1.435	7.577	1.345	0.02371	1.706	9.008	71.95
Three-ply No. 8 B. W. G. twisted guy wire (single-conductor), 25 cycles	5	1.024	1.044	5.512	1.018	0.02371	0.745	3.934	31.42
	10	1.028	1.063	5.613	1.034	0.02371	0.951	5.020	40.11
	15	1.040	1.115	5.887	1.073	0.02371	1.286	6.790	54.24
	20	1.045	1.205	6.362	1.152	0.02371	1.649	8.707	69.54
	25	1.062	1.270	6.706	1.195	0.02371	2.045	10.800	86.24
No. 6 B. W. G. "BB." telephone and telegraph wire (single-conductor), 60 cycles	5	1.670	2.540	13.41	1.525	0.01525	3.585	18.93	235.1
	10	1.675	3.260	17.21	1.950	0.01525	4.035	21.30	264.7
	15	1.695	3.375	17.82	1.990	0.01525	4.125	21.78	270.6
	20	1.750	3.325	17.56	1.900	0.01525	4.100	21.65	268.9
	25	1.840	3.220	17.00	1.760	0.01525	3.920	20.70	257.1
No. 6 B. W. G. "BB." telephone and telegraph wire (single-conductor), 25 cycles	5	1.670	2.140	11.30	1.281	0.01525	4.735	25.00	310.6
	10	1.695	2.550	13.46	1.508	0.01525	6.555	34.61	429.9
	15	1.720	2.570	13.57	1.494	0.01525	6.675	35.24	437.8
	20	1.755	2.515	13.28	1.433	0.01525	6.595	34.82	432.6
	25	1.820	2.495	13.17	1.373	0.01525	6.450	34.06	423.1

Threatened State Control of Water Powers*

Present Attempts to Authorize State Ownership of Water Powers Are Made Directly in the Face of Earlier Experiences of the States Which Resulted in Existing Constitutional Prohibitions Against Such Use of Public Credit

By PRESTON S. ARKWRIGHT
President Georgia Railway & Power Company, Atlanta, Ga.

THE first electric light I ever saw was exhibited in a circus, and they showed it, in connection with other wild animals that had been subdued and tamed by man, as a curiosity. Soon after that in the town where I lived a few individuals got together and formed a company, got up a crude central station and put some arc lights on towers high up in the sky, to shine in the night when the moon was not shining. The developments in the electrical industry have been big and fast since the old days, but these developments have not been brought about by governments, or by states, or by municipalities, or by socialists, or by communists, or by any other organization for the betterment of mankind. They have been brought to pass by the ingenuity, initiative and courage of individuals, and there has been no other industry that has shown the marvelous growth that the electrical industry has displayed.

There were a great many difficulties in the early days in the starting of this business. Nobody heralded us with any voice of acclaim when we started the business, nobody has fondled the electrical industry since it started; on the contrary, it seems to me, it has been necessary to fight almost every step of the way. But we have had constant reduction in price, constant improvements in service, constant improvements in the devices with which electricity is used, and practically all the benefits of economies and efficiencies in improved devices for the utilization of electrical energy have gone to the consumer.

INITIATIVE HAS DEVELOPED THE WATER POWERS

We have passed beyond the confines of the municipality and are hearing very little of the proposition for municipal ownership of electric light and power plants. We have reached the point where the electric light is not the only important factor in our work, for the greatest proportion of our output at the present time is used not for lighting purposes but for power purposes. The electric light industry brought to the fingertips of the people the energy which had been deposited in coal during the ages, and brought them a service on tiptoe to answer their summons for every known work or use that they could call this power to perform for them.

Among other things that the electrical industry is responsible for is the development of the usefulness of the water powers, those rivers which we hear so much about nowadays, which have been running to waste during the centuries and would have continued to run to waste through all eternity but for the development of the electrical industry, thus enabling us to bring the energy produced by these water powers to the centers of population.

It has not been very many years that it has been possible to transmit electrical energy developed from the water powers to the far-scattered centers of population, and yet we are having today a constant agitation in several sections of the country with regard to municipal ownership or state ownership of the water powers. The question has been agitated in New York every year since 1912, and yet New York stands first among all the states of the Union in the development of water power. It has been agitated in Maine year after year and defeated each year in the Legislature of Maine, and yet the State of Maine stands fourth in the development of water powers in the United States. It has been agitated for eight years in Idaho and defeated each time before the Legislature of Idaho, yet, in 1920, the first recognition that state ownership of water powers has gained in any of the states where it has been agitated was brought about by the insertion of a clause in the Constitution of the State of Idaho permitting the state to use its own resources to promote or develop the use of water powers.

State ownership of water powers has been agitated in the State of Georgia for the last four years. A bill was first introduced in the Legislature of 1919. It was defeated in committee. It was again introduced in the year 1920. It then received a majority vote of the committee. It was introduced again, but was defeated in committee, in the year 1921. It was introduced again in the year 1922 and defeated by a vote of thirty to one.

It has been proposed in the State of California year after year in the Legislature and defeated each and every time, and now we have in California a measure submitting to a vote of the people the amendment of the constitution and the creation of a water and power commission for the state ownership of water powers. California stands second among all the states in the Union in the development of water powers electrically and exceedingly low in the scale of rates charged.

In Nebraska the subject of the control of water powers has been agitated for some time, but it has never got beyond the stage of agitation in that state. It was suggested that a provision for state ownership of the water powers in Nebraska be inserted in a new state constitution, but it was defeated. The same thing has been proposed in Michigan for a great number of years, brought before the successive legislatures and defeated each time.

POPULAR IMAGINATION, NOT INTELLIGENCE, APPEALED TO

There is a lot of imagination and romance about this water-power business. A sample of the arguments used by advocates of state ownership in Georgia—and the same arguments are used elsewhere—is that there is enough power in the State of Georgia to light the homes,

*Abstract of an address delivered at the convention of the Association of Edison Illuminating Companies, White Sulphur Springs, W. Va., Oct. 10-14, 1922.

cook the food, run the dairies, saw the wood, pump the water, heat the homes, thresh the grain, gin the cotton, turn the wheels of every vehicle, run all the trolleys, and run all the trains in the state, bringing the people from darkness into light and lifting the drudgery from their shoulders. They never dreamed that it would take a billion dollars to do it—and it never could be done even if they had the billion dollars. They contend that the water powers have not been developed simply because there are undeveloped water powers. Surely that claim cannot be made in the State of California, where more progress in the development of water powers is going on than in any other state in this whole nation. It cannot be made as to the United States in general, because, although there is in North America only 15 per cent of the potential water power on the globe, there has been more water-power development, in capacity, in North America than in all the rest of the world combined. The development of the United States alone is 41 per cent of the total development of all the water powers in all the wide world, and this development has been brought about by individuals, at their own risk, on business principles, and not as a political scheme.

The agitation for state ownership of water powers has not sprung up in the states that are lagging in this development, but it has been greatest in the states where the development has been the greatest and the most progressive.

USE OF STATE CREDIT AN OLD STORY

It is not the first time that efforts have been made to use the credit of the state for improvements of this character. In the early thirties some of the states were greatly interested in the building of railroads. Now, while we claim that an abundance of cheap power is of vast importance to the territory and the people within it, I think we will admit that the question of transportation is of even greater importance to the progress of the country. So, in order to obtain railroads many of the states of the Union built railroads themselves. Originally there were no limitations in the constitutions of any of the states regarding the creating of a debt by the state, and it was held that the state had a right to do that in the absence of a prohibition.

So a great many of the states, in order to obtain railroads, built railroads themselves. It was a disastrous proposition for them. In some cases they finally sold the roads and in other cases leased the roads which the state had built at a very substantial financial loss.

The State of Georgia itself built a railroad from Atlanta to Chattanooga, a distance of about 132 miles, and tried to operate it by appointed officers. They could not operate it, and so they leased it to a company composed of individuals, and this company operated it successfully.

In addition to the building of railroads by state's credit, they loaned the credit of the states to many private corporations to induce building of railroads. These had the power to create debts, and the legislatures of all the states of the Union went wild piling up debt on debt. It is the same old story of spending somebody else's money, and they spent it with both hands, until the states of the Union were burdened with such an expense that eleven of them at one time or another repudiated these debts incurred on the faith and credit of the state itself.

So, out of that situation grew amendments to the constitutions or new constitutions. This movement included practically every state in the United States with the exception of Connecticut, Vermont, New Hampshire and Massachusetts, so that most of the constitutions of the states today provide that no debt shall be incurred by the state except to pay existing debts, to suppress insurrection, repel invasion, or defend the state in time of war. Thus nothing can be financed with the state's money. No matter how important the project may seem to be, no matter what the demand of the agitators may be, no matter what the desires of uninformed voters may be, the state's money and the state's credit shall not be used for any matter whatever except of a strictly governmental character.

Now, we have passed beyond the days of building railroads—we have found other game. It is not these little electric light companies that only furnish light over a comparatively small area, but the great power companies which serve widely extended areas, and we want to do for them exactly what the constitution, on account of the experience had with the building of railroads and other internal improvements, made it impossible ever to do again. So that the advocates of every one of these suggested laws in all of the states have proposed amendments to the constitution. They want to do exactly what formerly got the states into trouble, but in order to do it they must remove the precaution that was put into the constitution to prevent a recurrence of that very trouble, and thus every one of these propositions involves an amendment to the constitution of the state.

These agitations are not made by people who are interested in using power. In not a single one of the states where the matter has been agitated has it been sponsored by a power user or by any other considerable element of the population. It has been done by politicians, by some one who might have a particular grudge against a particular company, and by people who believe in the socialistic doctrine. That is true in our state, and it is certainly true in California, and my information is that it is true in all of the other states.

One of the arguments used most frequently with reference to the installation of water powers by the state is to point to the Ontario Hydro-Electric Commission. But the situation of Ontario is misrepresented in all of these states. I want to call your attention to how the expense rose. They started up in Ontario with seven towns lying near to Niagara Falls—they estimated they could develop the water power at Niagara Falls so as to deliver it at a cost of $4.95 per horsepower per year. Instead of what they estimated, it was $9.40 per horsepower per year, and while last year there was distributed 337,000 hp., the commission had itself developed only 46,000 hp., and of this 46,000 hp. which the commission had developed, it had actually only constructed the generative stations for 11,500 hp., the rest of it being simply additions in the form of stations which the commission had taken over and which had been built on individual initiative and enterprise.

They have spent on the project something like $175,000,000 or $200,000,000. Now, having got the water powers and involved the municipalities and the province in a debt of $200,000,000, they want to build electric railways and hydro-radials, at an estimated cost of $100,000,000 more. There is no limit to the ambitions of people in political office, with the unlimited credit of the state or government behind them, and they will

spend money hand over fist, so that they may say, "We have the biggest water-power development," or "the longest miles of transmission line," or "the greatest railway mileage," etc.

The question regarding prices for electricity generated by waterpower are misleading in the form in which they are generally stated. I want to call your attention to the fact that they have in Toronto, so far as I know, the lowest rate for residential lighting in North America, a maximum of 2.5 cents per kilowatt-hour. You know and I know that is below cost. You know and I know that if the energy costs nothing you cannot deliver it at any such rate. But it is done intentionally and it is done deliberately, because it serves to interest directly the greatest number of voters, and it is the argument that is used in the United States with the greatest possible effect.

In our city we furnish residential lighting at a maximum of 8 cents, and I suppose that, taking the country as a whole, the average would be something like 7 cents as a maximum rate. The comparison is made in various parts of the country between that rate and the 2.5-cent rate in Toronto. You can get up statistics and data about the average rate and show that the average rate received in Buffalo, or Montreal, or Quebec, or the average rate received in California, is much less than the average rate of the Ontario Hydro-Electric Commission, but the ordinary voter and householder cannot see beyond the difference in his residential lighting rate.

NO REAL REASON FOR STATE OWNERSHIP

For my own part, there is less reason for government ownership of water powers than for almost anything else I know of. The water powers were not designed by God for lighting purposes—they were designed by Nature for power uses. And unless you can get the power loads they will not justify their development; unless you can get power loads from customers with a good demand, water-power development of considerable size can hardly be undertaken. And that business is strictly competitive.

I do not think that any of these agitations for state ownership of water power will succeed. They have never made any headway in Georgia. They have made very little headway in any of these other states, and my opinion is that the proposition will be defeated in November in California. The agitation will tend constantly to recur; but I hope that its decided defeat by a vote of the people of California may help to silence it in all the other states.

Don't you think for one minute that what these people want is to develop more water power by the state—they want to drive out private ownership and individual initiative, and to do that is a dangerous thing. Sir Adam Beck, chairman of the Ontario Hydro-Electric Commission, in his testimony before the United States Congress in 1918, said that the ultimate aim of the plan is the elimination of the private or independent companies. At that time they had bought out eighty private companies, and since then I think that they have bought them all out.

One of his associates visited Georgia during this agitation, and he said that they believed in the monopoly of the power business and their aim was to place these monopolies in the hands of the government. The man who led the agitation in Georgia, particularly against us, against our interests, stated on one occasion that if this business had to be in private hands, he would rather that it should be in the hands of the people in whose hands it then was in Georgia than in anybody else's hands, but that they were violently opposed to private ownership. So it is not a proposition to develop additional water power. The agitation is born of a prejudice against individual reward for individual energy, enterprise, initiative and effort.

It is contrary to the very principles on which we have carried forward the administration of this country since its formation. It is a substitution of socialistic ownership for individual company rights—and don't think that it ends with water powers. If this movement succeeds in the case of water powers, it is simply the beginning of the suffocation of enterprise and the death knell to prosperity in this country.

Development of Incandescent Lamp for Street Lighting

BY A. D. CAMERON
Supply Department General Electric Company

THE commercial introduction of the incandescent lamp was started in 1880, current being distributed by a constant-potential, multiple system of wiring. The series system was being successfully used for street lighting with the carbon open-arc lamp, and as a demand came for a smaller street-lighting unit a series incandescent lamp was developed. The first lamps made were for about 1¾ amp. and in two sizes, 16-cp. and 32-cp. A special high-voltage direct-current dynamo was developed, generating about 500 volts, and the lamps were burned in series on this voltage, this being known as the "Municipal" system.

Series open-arc lamps were designed to operate at about 10 amp. It was not possible to make a good incandescent lamp for this high current as it required too thick and short a carbon filament. Later, when the series inclosed-arc lamp was developed for 6.6 amp. and 7.5 amp., a few carbon incandescent lamps were made to operate on these circuits, but they were not entirely successful. By this time larger sizes of lamps were being used, so that incandescent lamps of 16, 20, 25, 32, 40 and 50 cp. were available.

About 1905 the "Gem" series incandescent lamp became available. This had a metallized carbon filament and was 25 per cent more efficient than the previous carbon lamp. It was made in the same sizes, but was soon supplanted by the tungsten-filament lamp, which appeared in the latter part of 1907. This lamp was four times as efficient as the carbon lamp and soon drove the carbon and "Gem" series lamps out of the market. Tungsten-filament series lamps could be made for the higher amperages, and soon the 6.6-amp. became the standard series circuit with these lamps. They could also be made in even larger sizes, up to 400 cp., and were much more efficient than the inclosed carbon arc lamp, which gave only about 200 cp. and which, therefore, soon disappeared from use.

About 1913 the "Mazda C" lamp, with its tungsten filament operating in an inert gas, was put on the market, it being 50 per cent more efficient than the vacuum lamp. This made it economically possible to make even larger sizes, 600-cp. and 1,000-cp. and later 1,500 cp. and 2,500 cp.

Even further progress must be made to satisfy the demands of the people for brighter, lighter streets.

The Cost of Electric Service

A Method of Analyzing the Costs of Central-Station Service to the Consumer Devised by an Iowa Company—The Plan, Based on Regular Accounting System, Reduces Book Accounts to Unit Consumer, Capacity and Energy Costs

By W. J. GREENE, C. F. SCHOONMAKER and C. B. GORTON

THE cost of service to the various classes of consumers of an electric light and power system has been a debated question on which different authorities making an analysis of the same property are quite likely to disagree. Frequently the disagreements will exhibit serious differences. This is due largely to the fact that no method generally accepted for utility cost allocation has been developed. A large amount of effort in this direction has been expended in the industrial field, and in the modern quantity-production factory very accurate methods of determining costs have been developed and the executives in charge know at all times where any department, or the business as a whole, stands. There seems to be no logical reason why the same thing cannot be done for any utility if a careful study of the conditions is made, the proper plan of handling the records developed and cost allocation made a matter of routine accounting.

A Plan Developed

Several years ago the Iowa Railway & Light Company made an agreement with a large consumer to supply high-pressure steam and electrical energy on a cost-plus basis. This required a plan of accurately determining and allocating the costs of steam and electric service each month. The method adopted proved so satisfactory that it has been developed and extended to cover all classes of consumers supplied by the company. The territory served by the company covers a large portion of the central part of Iowa from east to west, service being given to towns and cities the largest of which is Cedar Rapids with a population of 45,556. The majority of the towns are small, and the problems involved in the distribution of costs are typical of those encountered on any widespread transmission and distribution system. In some ways there are more complications than are to be found on many systems as central-station heating is supplied from some of the plants, making an additional complication in cost allocation.

In describing the method the term "cost" is used to cover all costs, including operating expenses, taxes, depreciation and amortization. To these is added a factor termed "money costs." This term is used in place of the term "interest," and the term "money rate" in place of "interest rate." The usual method of handling money costs is to treat them as the return on the fair value of the property. It is believed that any statement of costs that is correct must include all the above items. These items are therefore included in the costs that are allocated by routine cost accounting.

The foundation of the manual for the determination of unit costs developed by the Iowa Railway & Light Company is the uniform system of accounts for electric corporations recommended for adoption by state commissions at the annual meeting of the National Association of Railway and Utilities Comissioners in Washington, Nov. 12, 1920. For purposes of cost accounting this system of accounts is not entirely satisfactory. Some of the fixed capital and operating expense accounts do not represent natural divisions from the standpoint of the use of the property, materials and supplies, and labor. An ideal classification would be one in which each division or subdivision could be used in the cost accounting without further subdivision. However, by providing certain sub-accounts or by keeping details of certain accounts, the classification referred to, or any other classification by a proper reconstruction of the reference numbers, will give the desired results.

The ratios developed for the allocation of the major portion of the costs are based on data established within accuracy of the meters and the records of the consumers. It has been necessary to develop a few ratios based on a careful study of the conditions, but even if given the widest possible variance, the maximum error in results would be a very small percentage. They may not be numerically correct for all properties, and they may, on further study, be modified for the property for which they were developed. It is believed, however, that the method as a whole is fundamentally correct and commercially accurate, although it is expected that a more extended study and further experience with some of the details will result in a somewhat closer accuracy.

Outline of the Method

Starting with the standard accounts, the fixed-capital items are grouped. The main plant-investment cost items are grouped under the general heads of "steam electric," "hydro-electric," "gas electric" and "storage battery," with the subdivisions of land, structures and equipment under each. The transmission system investment costs are handled in the same way. The distribution system accounts are "land," "structures," "distribution substation equipment," "distribution lines," "transformers," "service" and "meters." The distribution lines are sub-grouped as "underground conduit," "underground conductors," "poles" and "overhead conductors." The miscellaneous items are "commercial lamps," "municipal street lighting equipment" and "electric appliances." Each group is subdivided as far as its service will permit into sub-groups covering the general light and power system, municipal street-lighting system, special power customers and rural service system. The general property accounts are grouped under the headings of "lands," "structures," "equipment" and "miscellaneous tangible capital." Provisions are made for introducing in the cost accounting items of investment expenses covering insurance, taxes, depreciation, amortization and money costs, and for accurately determining these rates and charges entering into the investment expenses. The net result of the grouping is to finally set up a total investment cost for each subdivision of the fixed-capital accounts

which represents the fixed charges that are part of the cost of service.

The handling of the steam-plant investment and operating expense is more complicated in the case of the property under consideration than would be the usual case, as it has been necessary to provide for the segregation of the expenses between the electric service, the exhaust or steam-heating service and the live-steam service. The total expense of the steam plant is first grouped into "energy," "capacity" and "indeterminate expense." These are in turn distributed to the electric, the exhaust and the live steam uses on a basis determined by the actual steam used by each system, the responsibility of each system in creating the demand for steam, and a combination of both respectively, a small portion of the expenses being arbitrarily apportioned 50 per cent by responsibility and 50 per cent by quantity used. One item that is set out in the cost analysis is that of ineffective and effective fuel. It is believed that a record of these items will assist materially in improving plant efficiency. The ineffective fuel is the fuel used in banking boilers and bringing banked boilers to working condition.

TRANSMISSION LINES TREATED AS BUS EXTENSIONS

Up to this point the plan has dealt with only the plant investment or fixed charges and operating expenses. In introducing the transmission investment or fixed charges and operating expenses the transmission lines, including transmission substations, have been treated as extensions of the central-station bus and are grouped with generating-plant costs. The combined result is a total expense that is allocated to transmission centers. This expense is grouped under the headings of "electrical energy," "electric capacity" and "electric indeterminate expenses." The electrical energy is subgrouped as ineffective and effective energy expenses. The groups are allocated to the transmission centers on a basis determined by the electricity used, by the responsibility of each center in the creation of load on the generation and transmission system, and by a combination of use and responsibility.

The distribution centers in turn receive their allocated portion of expense from the transmission centers, which with the distribution substation expenses, grouped as operating and investment expenses, comprise the distribution centers' expenses. The distribution centers are carried as class A and class B. The class A are those for which it is thought desirable, because of size or other special reasons, to determine costs monthly. In general, the costs for the smaller centers are determined on an annual basis. To the costs allocated to the distribution centers are added the costs incurred in each center for the expense of distribution. These expenses are then allocated to what are termed the systems of the distribution center. These systems are "general light and power," "municipal street lighting," "special power," and "rural."

The commercial office expense for the electric department and the general office expenses are still to be added to the cost figures for each distribution center. The total operating expense of the commercial electric department plus the investment or fixed charges of the electric department are assembled and in turn apportioned to the distribution centers on the basis of the number of consumers served. In case a consumer is served from a transmission center he is treated in this allocation as an independent center of distribution. The expenses classed as commercial office are those incurred in reading meters, billing and the other expenses involved in handling the consumer records. The general expense items are assembled and divided into two factors, one an expense and the other a consumer element factor. This is done because certain parts of general expense are incurred in handling consumers and should be considered in the final determination as consumer expense. The consumer element part of general expense is allocated to the distribution centers on the basis of the number of consumers, and the expense element is distributed on an expense ratio basis to the distribution centers.

The final result of the series of allocations outlined above is the grouping under the head of each distribution center of a proportion of the total fixed and operating expenses of each system. The expense of meter shunt and line transformer core losses are determined and added to the expense of each of these centers. In each of these groups there is, therefore, a collection of cost data which represent the costs of a general light and power system, a municipal street-lighting system, a special power consumer and a rural system. Except for the rural system, these items represent costs that will probably need no further subdivision, or, at the most, a very slight subdivision that will be determined by the conditions in each case. For the purpose of this discussion the rural system will be ignored, as the distribution of costs in the general light and power system, which represents the major item, is most important and the distribution of the rural service costs, once determined in total, should be comparatively simple. The

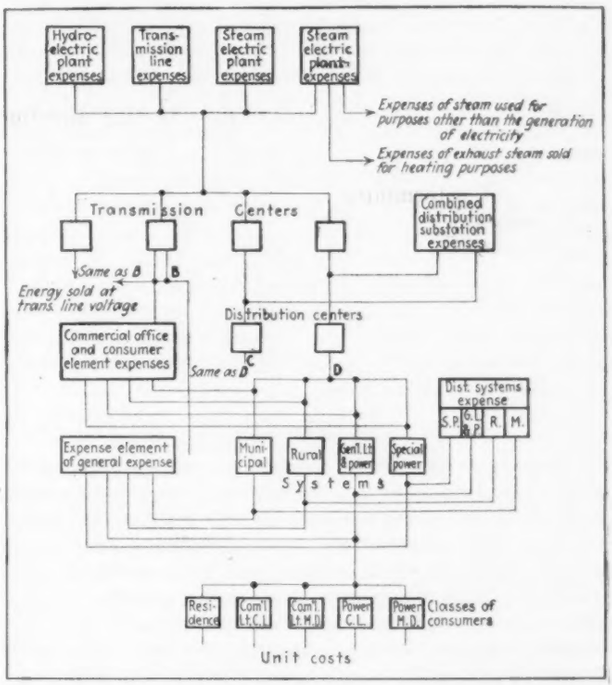


CHART OF ACCOUNTING SYSTEM OF A MIDDLE WEST UTILITY

The Iowa Railway & Light Company, Cedar Rapids, Iowa, has developed a method of allocating costs so that the final result is the expression of the usual investment and operating figures contained in the accounting groups of the ordinary central-station books in terms of unit consumer, capacity and energy costs for the various groups of consumers served. The system is designed as an integral part of the accounting work. This illustrates graphically the relation of the various grouped items of expense to each other and the final unit costs to the different classes of service. The general procedure is explained in the accompanying article.

items of a general light and power system's costs must be properly apportioned to the consumer, capacity and energy elements or costs. Most of the costs are easily apportioned to the proper element or elements. For example, the item of meter loss expense and also that of commercial office expense is clearly a 100 per cent consumer cost. Similarly the effective energy expense which covers the cost of energy actually put on the transmission lines for distribution is clearly 100 per cent energy expense. In passing it is interesting to note that this item is almost the only energy expense, only one other item contributing anything to this element.

To handle the groups that are either indeterminate or contain costs belonging to more than one of the groups, a series of ratios are used to allocate them to their proper element or elements. As an example of the application, the poles and fixtures and overhead conductor groups are equally divided between consumer and capacity expense. With the allocations made the consumer and energy costs can be reduced to a unit-cost basis by dividing the total consumer cost by the number of consumers and the total energy cost by the number of kilowatt-hours sold during the period covered by the expense. It should be noted in the latter case that the cost is in terms of kilowatt-hours measured by the consumers' meters, thus automatically correcting for line losses. The consumer costs will be on an annual or monthly basis, depending on the period covered by the cost figures.

Allocation of Demand Costs

Allocation of the demand costs is a more complicated process and is carried out as follows: Two factors are used, one being maximum demand and the other a factor that has been named peak responsibility. In determining the value of these factors the consumers are classified. With the residence class the manufacturer's rating of the largest device used is taken as the maximum demand with a minimum of 1 kw. The commercial lighting connected load class is given a minimum of 500 watts. The commercial lighting measured demand class has a maximum demand equal to twice the highest kilovolt-ampere-hours measured in any thirty-minute interval. Corresponding to this is a general power measured-demand class on the same basis and general power connected-load class which has a minimum demand of 1 kw., 1 hp. being taken as the equivalent of 1 kw. The peak responsibility is the demand of a consumer or group of consumers at the time of the combined maximum load on all sources of supply.

It will be seen that this does not necessarily correspond with the individual or group maximum demands. The maximum demand and peak responsibility of the various groups is determined by selecting a number of smaller groups of consumers from each of the major groups and determining the values by measurement. This should be done for a number of small groups of customers in each major group. As will be readily seen, these two factors are not likely to coincide in value. The sum of the demands of the consumers divided by the peak responsibility of any group is the peak responsibility factor of the group. The average of this factor for a number of similar groups is taken as the peak responsibility factor of a class. The sum of the maximum demands of a group divided by the maximum demand of the group is the maximum-demand factor of the group, and the average of a number of these factors for similar groups is taken as the maximum-demand factor of the class. In making these determinations the tests must be extended over a sufficient time and the various groups selected for test to insure representative results.

Use Peak Responsibility Factor

In determining the unit-demand costs the sum of the consumers' demands of each class is divided by the class peak responsibility factor. The results of this calculation give the peak responsibility of each class, and the ratio of each of the results to the sum is then calculated. This set of ratios is used to multiply the power-plant and transmission capacity costs allocated to the general light and power system. The results are the peak responsibility costs of each class. The sum of the consumers' maximum demands of each class is divided by the maximum-demand factor of the class, and the ratio of each result to the sum of the results is obtained. These ratios are used as multipliers of the distribution substation and distribution systems demand costs allotted to a general light and power system. This result gives the demand expense of each class. The sum of the peak responsibility expense and the maximum-demand expense of each class is found and divided by the sum of the consumer's demands of the respective class. The result is the unit-demand cost of each class, which will be on a yearly or a monthly basis, depending on the basis on which the cost figures have been taken. It is believed that the greater knowledge obtained from the general use of the method over an extended period will result in a refinement in the classification of consumers.

The allocation of costs of the generation and transmission system to the transmission and distribution centers has been mentioned as being made on a ratio basis. The method of arriving at the ratios in each case is based on measured quantities. In allocating the distribution, commercial office and general expenses concrete data are used, except in a very few cases where necessary data are not available and an estimate is the only possible method. However, the plan is designed with the thought that eventually every important factor will be determined by measurement and that experience in the minor factors will make it possible to place the final result on as definite a basis as the cost accounting of any industry.

The next issue of the *Electrical World* will contain the second part of this article, which will deal with specific applications of the general principles outlined in the first part of the article.

Power Club Publishes Control Handbook

A SIMPLE description of controllers for electric motors and definitions of the terms used in that connection have been compiled by the Electric Power Club and published in a handbook. Words which do not appear in the regular dictionaries are here explained in simple language, and in addition to being a handbook for users of electrical control apparatus, it gives the meaning of terms with which all users of electrical apparatus should be familiar.

The handbooks may be obtained from leading manufacturers of electric power and control apparatus or from the Electric Power Club, Kirby Building, Cleveland, Ohio.

Use of High-Power Vacuum Tubes

Characteristics, Operation and Connections of 20-Kw. Vacuum Tube Used for Transatlantic Radio Service—Description of 1,000-Kw. Power Tube and Its Possibilities—Overcoming Space-Charge Effect and Filament Excitation

By DR. IRVING LANGMUIR

Assistant Director Research Laboratory, General Electric Company

THE engineering development of high-power vacuum tubes for radio has progressed so successfully during the last few years that other uses for such tubes appear as more or less definite future possibilities. Although progress in this direction is more difficult and is apt to be slower than in the direction which has thus far seemed more important, the author believes that it would be rash to predict the limitations of the ultimate use of vacuum tubes in the power field.

THE recent tests at Rocky Point, L. I., using 20-kw. pliotrons as a source of radio-frequency power have demonstrated the practical operation of high-power vacuum tubes. The Alexanderson multiple-tuned antenna was used, supplied by high-frequency current from six 20-kw. pliotrons running in parallel, and during a sixteen-hour test signals were transmitted to Nauen, Germany, and came in from there. These signals were in addition to those usually transmitted with the Alexanderson alternator.

The tubes used in this test, like the ordinary vacuum tubes used for receiving radio signals, contain three electrodes, the filament, the grid and the plate, and to this extent they incorporate the principle first brought forward by De Forest. By the use of a very high vacuum and by special features of construction, ionization due to a gas residue is brought down to negligible value, and in this way it has been possible to develop pliotrons capable of operating at higher and higher powers. The present 20-kw. tube marks simply one step in this development. The original De Forest audion operated with currents of at most a few milliamperes and at voltages of 30 or 40, so that the power which could be controlled was about 0.1 watt or 0.2 watt. By using the new principle of a pure electron discharge, independent of gas ionization, it was possible to develop tubes for transmitting purposes. These were used widely during the war for small radio-telegraph and radio-telephone sets. Gradually tubes of 50 watts and 200 watts were developed, using tungsten filaments as cathodes and with plates of metallic molybdenum capable of operating at such high temperatures that they could dissipate by radiation relatively large amounts of power. During the last few years tubes of this type of 1 kw. and 5 kw. capacity have been developed. The molybdenum anodes in these larger tubes are of cylindrical form and operate at high temperatures so that they can radiate the heat through the transparent glass wall of the bulb.

In going to larger powers it becomes difficult to make an anode of sufficient size to radiate the energy dissipated, and therefore resort has been had to water-cooling the anode. In this way the glass bulb was avoided entirely except as a means of insulating the leads connecting the electrodes to other external circuits. The anode, instead of being inside of the tube, is made to be the envelope of the tube. This introduces several new problems, for it is necessary to make a vacuum-tight seal between the cylindrical anode of relatively large diameter and the glass tube through which the leads are brought. Furthermore, new problems arise in connection with maintaining sufficiently high vacuum in a metal container in which large amounts of energy are being dissipated. These and other similar problems have been worked out largely as a result of several years' work on the part of W. C. White and H. P. Nolte.

Fig. 1 is a photograph of the outside of the 20-kw. tube, which has already been manufactured in relatively large numbers and is commonly known by the type number UV207. It is seen that the lower part of the tube consists of a copper cylinder of about 1.9 in. outside diameter and about 8 in. long. This is sealed to a large glass tube of about 2.75 in. diameter by means of a conical thin-metal portion consisting of copper-covered nickel steel, this material acting as a substitute for the very expensive platinum which might otherwise be used. The upper glass portion of the tube is about 10 in. long and serves merely to support and insulate the filament leads from the grid and anode.

Fig. 2 is a photograph illustrating the interior construction of the tube. The cathode is a heavy tungsten filament of about 0.04 in. diameter bent in the form of a "W" supported on stout tungsten rods. It requires about 50 amp. heating current at about 20 volts, thus consuming about 1 kw. The plate or anode operates at about 15,000 volts direct current with respect to the cathode. The outside of the plate cylinder is directly in contact with running water supplied at the rate of about 2 gal. to 3 gal. per minute.

OVERCOMING THE SPACE-CHARGE EFFECT

Because of the possibility of dissipating a large amount of power from the water-cooled anode it is possible to make this anode relatively smaller—in fact, much smaller than is used in the 5-kw. tube. This aids greatly in overcoming the space-charge effect which is a feature limiting the efficiency of electron tubes. These 20-kw. tubes have therefore a rather higher efficiency than the low-power tubes with molybdenum anodes. In the production of radio-frequency power these tubes give an output of 20 kw. in an antenna with a plate efficiency of 75 per cent, the filament loss of 1 kw. reducing the over-all efficiency to about 70 per cent. This is by no means the limit of the efficiency that these tubes can give. If used for lower frequency, considerably higher efficiencies may be obtained.

The particular set-up used in the recent tests is illustrated in the diagram of Fig. 3. The power is supplied from a three-phase, 60-cycle, 22,000-volt line.

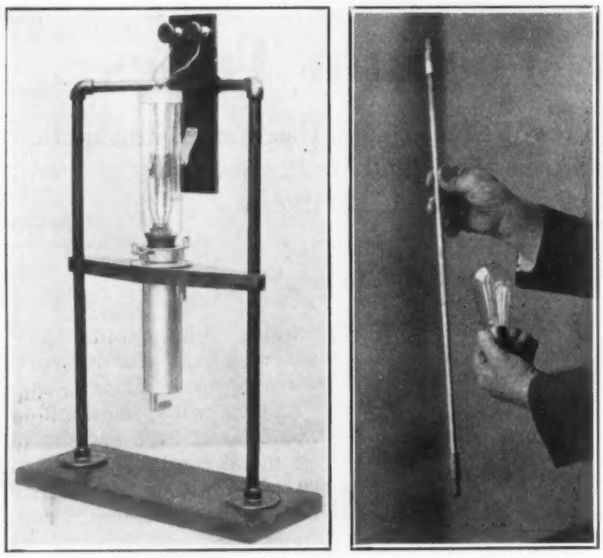


FIG. 1 — LEFT: EXTERIOR VIEW OF 20-KW. TUBE WITH WATER-COOLED PLATE. RIGHT: FILAMENT OF 1,000-KW. TUBE COMPARED TO A 40-WATT LAMP

Each phase is grounded through a reactor and is also connected to the anode of a water-cooled kenotron. These kenotrons are constructed just like the 20-kw pliotrons except that the grid is omitted. The filaments of the kenotrons are excited by an insulated filament transformer fed from 110-volt, 60-cycle current. In the recent Rocky Point tests, carried out by co-operation between E. F. W. Alexanderson, C. W. Hansell of the Radio Corporation of America, W. R. G. Baker of the radio department of the General Electric Company and H. J. Nolte and W. C. White of the research laboratory, three kenotrons were used for rectifying the alternating current supplied. The power from the kenotron outfit was smoothed out by a capacity C_1, shown in the diagram. This direct-current power supply was further smoothed out by the choke coil L_1, or 50 millihenries. This direct-current power, ranging from 10,000 volts to 15,000 volts, was then applied to the plates of six pliotrons operating in parallel. The grids

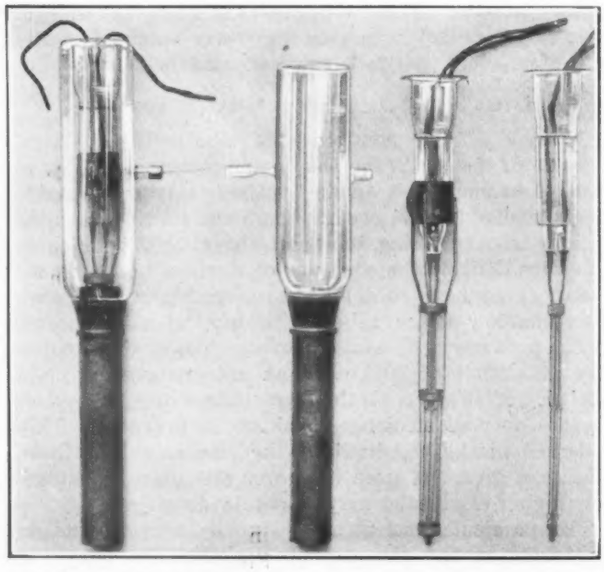


FIG. 2—INTERNAL DETAILS OF THE 20-KW. RADIO-TYPE TUBE

of these pliotrons were excited by a master oscillator giving about 1,250 volts and capable of delivering about 1.5 kw. of high-frequency power. The grids were operated in parallel, each grid being provided with a grid leak and grid condenser. The connection to the antenna from the plate circuit was made by means of the condenser C_2, which was tapped into the antenna circuit at a point in a series of condensers C_3, connecting the antenna with the ground. The antenna itself was connected to the condensers C_3 through the tuning coil L. The antenna was of the multiple-tuned type which has been described by Alexanderson.

In the tests recently made where signals were transmitted to Nauen the antenna current was about 310 amp., which is about one-half that used ordinarily with the Alexanderson alternator. No particular effort was made to obtain the full output of the tubes in these tests, and undoubtedly more than twice as much power will soon be obtained from a similar number of tubes. The tests have demonstrated on a larger scale what

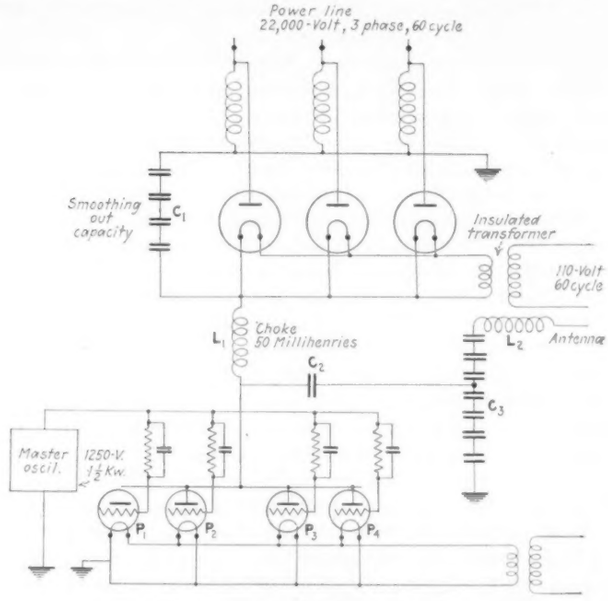


FIG. 3—SET UP FOR TRANSATLANTIC RADIO TESTS, USING 20-KW. TUBES

we have already known from laboratory studies of individual tubes, that these tubes are capable of thoroughly satisfactory operation with an output of about 20 kw. The filament design is conservative, so that the life of the tubes should average several thousand hours in actual operation.

The practical utilization for radio purposes of these 20-kw. tubes marks merely a step in the application of the basic principle of the pliotron. Since 1912, when this development was first begun, the energy controlled by the three electrode tubes has been increased from the 0.1 watt or 0.2 watt of the original audion up to more than 20,000 watts, an increase more than a hundred-thousandfold.

This has been accomplished as the result of a careful study of the fundamental principles involved in the conduction of electricity through high vacuum. The writer's own work in this field was published in 1913 in the *Physical Review**, and the first work in applying this principle in the construction of vacuum tubes was described before the Institute of Radio Engineers early

*Physical Review, Vol. II, page 450, 1913.

in 1915.† In order to get large powers, of course, it has been necessary to use both larger currents and higher voltages than were originally used. This has been made possible by an understanding of the harmful effects produced by gas ionization and the discovery of means of avoiding these effects.

Larger tubes than those rated at 20 kw. are being constructed. A 100-kw. tube of nearly the same type as the present 20-kw. tube is now being developed by W. C. White and H. J. Nolte and promises to be fully as successful as the present tube, in addition to having the advantage of somewhat higher efficiency.

Another quite different type of tube, involving the principle of magnetic control proposed by Dr. A. W. Hull and called by him the magnetron, has been constructed by J. H. Payne. This tube, of which a photograph is shown in Fig. 4, consists essentially of a water-cooled cylindrical anode 30 in. long and 1¾ in. in diameter. In the axis of the anode is a tungsten filament 0.4 in. in diameter and 22 in. long. This filament is excited by current of 1,800 amp. at 10,000 cycles, the filament excitation requiring about 20 kw. The magnetic field produced by this large heating current is sufficient to "cut off" the electron current from the cathode to the anode during a portion of each half cycle of the current passing through the cathode, this action taking the place of that of the grid in the three-electrode tube. The electron current to the cathode is thus interrupted 20,000 times per second. By the use of properly tuned circuits this can be used for the production of high-frequency power for radio or any other purpose. The particular type shown in Fig. 4 will supply 1,000 kw. of 20,000-cycle power at an efficiency of 70 per cent, operating with an anode voltage of 20,000 volts direct current.

For radio purposes efficiencies of 70 and 80 per cent are eminently satisfactory, but for other engineering purposes they are not so high as would be generally desired. Another line of development is therefore in progress, viz., the production of tubes of higher efficiency as well as tubes of larger output. The progress in this direction is more difficult and is apt to be slower than in the direction which has thus far seemed more important. There are two main causes of loss of power in vacuum tubes: the space-charge effect and the filament excitation. By use of higher voltage and in other ways it is possible to reduce the space-charge loss very materially.

The energy loss in heating the filament can be reduced to one-tenth, or even less than one-twentieth, of that necessary with a pure tungsten cathode by employing a "thoriated" tungsten filament under very special conditions which have been the subject of study during the last few years.

The advantage of the thoriated filament is due to an adsorbed film of metallic thorium on the surface of the filament, this film consisting of a single layer of atoms. The thorium as fast as it evaporates off the surface is supplied by diffusion from the interior of the filament. In utilizing this effect a particularly high degree of vacuum is desirable, or at least the presence of those gases must be avoided which would oxidize or otherwise combine with the very thin film of thorium. For this purpose the vapors of various reducing materials, such as magnesium, or alkali metals, such as potassium substances containing carbon, have been used. Very successful results have been obtained in adopting this thorium filament in power tubes. At present the necessity of using this more efficient cathode is not very pressing, but with a future demand for high efficiency it will be possible not only to cut the energy necessary for filament excitation down to a small fraction of what it now is, but at the same time the life of a cathode can be increased enormously, so that the practical applications of electron tubes of large power will certainly not be limited by an unduly short life.

These developments will come gradually, for the practical construction of powerful tubes giving thoroughly satisfactory operation requires a great deal of development work. It would be rash, however, to predict the limitations of the ultimate use of vacuum tubes in the power field.

†*Proceedings of Institute of Radio Engineers*, September, 1915.

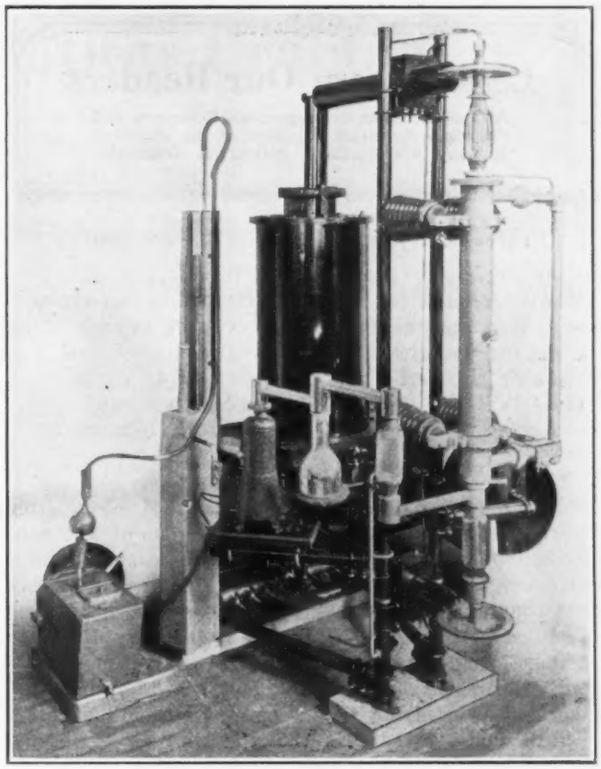


FIG. 4—A 1,000-KW. POWER TUBE OCCUPIES LITTLE SPACE

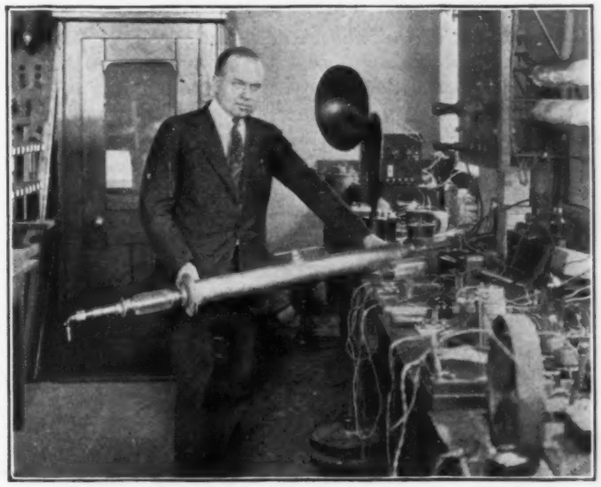


FIG. 5—BUSY DEVELOPING THE 1,000-KW. TUBE IN THE GENERAL ELECTRIC RESEARCH LABORATORY

Letters from Our Readers

A Place Set Apart for Suggestions, Comments and Criticisms, to Which All Men of the Electrical Industry Are Cordially Invited to Contribute

Professor Ryan for A. I. E. E. Presidency

To the Editors of the Electrical World:

The inclosed letter from Mr. Osgood is self-explanatory. I can think of no better way of accomplishing the general knowledge of his position than to ask you to include this letter and his letter in an early issue. I trust that you will find it possible to comply.

Milwaukee, Wis. A. W. BERRESFORD.

A. W. BERRESFORD, Milwaukee, Wis.

DEAR BERRESFORD: I am in receipt of your letter regarding Institute matters and am glad of the conclusion which you and the others have reached. As a matter of fact, I have not at any time seen how any other conclusion was possible. Professor Ryan appeals to me as I am sure he will appeal to every Institute member. Aside from making evident the national character of the Institute and the fact that the choice of its president need not be determined by his contiguity to headquarters, there is the man himself. He has been an outstanding leader in electrical engineering. His work is internationally known and approved. His personal characteristics are such that all men love him, and I know that only his own modesty has prevented his accepting a nomination at an earlier date. The Institute should take advantage of his consent.

Will you transmit to those who voted for me last year and have advanced my name this year the fact that I would appreciate their transferring their support to him? Also, will you make sure that this is so generally known as to prevent misunderstanding? My impulse was to do this directly as soon as I knew there was a possibility of Professor Ryan's consenting to run, but I realized that this would hardly be fair to you and the others who have been good enough to interest yourselves in my behalf. Sincerely yours,

Newark, N. J. FARLEY OSGOOD.

Fusing the Neutral Wire

To the Editors of the Electrical World:

I have noted with interest the comments published in the *Electrical World* regarding the fusing of the neutral wire. In the articles published the facts concerning danger to life have been brought out, but there is the damage caused to appliances and devices, which are costly, to be considered also. I will mention a few such instances which I know of.

One was that of a range where the neutral fuse blew and caused an unbalanced load and voltage enough to burn out all of the top plates which happened to be on the high-voltage side of the line. The customer was put to great inconvenience until repairs could be made. Moreover, the occurrence was expensive to him. There was also a case of the neutral fuse blowing at a church just before the beginning of the evening service. Although the fuse was soon replaced, so many of the lamps had been burned out by the higher unbalanced voltage that the congregation were unable to read the hymnbooks.

Both cases above mentioned had the effect of damaging the reputation of the service for reliability, and certain complaint of the expense and inconvenience was incurred. The occurrences were beyond the control of the utility concerned, because we all know that people in general know enough to put in a new fuse where one is blown, but they do not understand the correct amperage for fuses nor the proper sizes for the several places.

The underwriters have been criticised, but I hope that it was all meant in the constructive spirit. They have a side of the argument which is reasonable. There are several arguments in favor of the solid neutral.

In this day we are all talking and acting "safety." There has been offered to the manufacturers a device which will both solve the underwriters' objection and at the same time make for considerable more "safety" in the various other uses of the current. Now that a solution is offered which will not add to expense, let us take advantage of it and settle the question.

Janesville Electric Company, Janesville, Wis. G. R. BLAKESLEY, Commercial Manager.

Reports Should Be More Specific

To the Editors of the Electrical World:

I am much interested in the article by Edward Britt in the *Electrical World* of Oct. 7, page 776, entitled "Pulverized Waste Coal Efficiently Burned," which gives a description of a test of low-grade fuel in a French boiler plant.

Similar fuel has been burned in pulverized form quite extensively in this country for the last two or three years, using what is virtually dust and culm, mine dirt, etc., from anthracite coal. The largest equipment, which is supplied by six Fuller pulverizing screen mills, is for twelve 500-hp. and 600-hp. boilers of the water-tube type and operating a 10,000-kw. electric power station. It has been in successful operation over a year and a half, and the owners are so well satisfied that they contemplate building a similar plant in a different locality which will use the same class of fuel. The efficiency of boiler and furnace of 80 per cent and more is maintained regularly, from the B. t. u.'s in the coal as fired, when developing from 150 to 200 per cent of boiler rating.

The details given in the article you print are not altogether consistent, and the statements are rather misleading and need to be clarified to make them more definite. For instance, in the fourth paragraph it is stated that the average evaporation per pound of fuel is 7.38 lb. of steam, which corresponds to an over-all efficiency of 82 per cent, boiler and furnace. Figuring backward, based on the B. t. u.'s in the coal of 10,728 per pound, 82 per cent boiler and furnace efficiency would give an evaporation of 9.06 lb. from and at 212 deg. F. On the other hand, if the evaporation given as 7.38 lb. of steam is from and at 212 deg. F., this would mean only 66 per cent boiler and furnace efficiency. As the feed-water temperature during the test and the boiler pressure are not given, it is difficult to interpret the figures correctly.

This letter is not intended as a criticism of the test in any way, but if the statements could be elaborated in order to bring out the actual facts of the operating conditions, it would add to the value of the information given.

Fuller Engineering Company, Allentown, Pa. FREDERICK A. SCHEFFLER, Manager Power Department.

Industrial and Station Practice

Installation, Operation, Test and Repair of
Generating and Distribution Equipment and Methods of Economically Utilizing
Electrical Energy in Mills and Factories

Analysis of Costs in Gas-Engine Plants

CONSTRUCTION cost data and itemized operating costs for internal-combustion-engine power plants were given in a paper presented by D. M. Petty, superintendent of the electrical department, Bethlehem (Pa.) Steel Company, at the recent convention of the Association of Iron and Steel Electrical Engineers at Cleveland. The installed cost per kilowatt of a gas-engine power plant made up of three or more 4,000-kw. units is given in Table I. Operating costs per kilowatt-hour are shown in Table II for a similar plant made up of six 3,000-kw. units and one 4,000-kw. unit.

TABLE I—INSTALLED COST PER KILOWATT CAPACITY FOR A GAS-ENGINE POWER STATION WITH 4,000-KW. UNITS

	Cost per Kilowatt	
Building, modern construction, brick and steel, tile floors and crane, including exhaust tunnel and stacks	$7.50 to	$15.00
Foundations for engines, including excavation at $15 per cubic yard	4.50 to	9.00
Engines, including all piping and painting and ready to run	60.00 to	75.00
Gas-cleaning apparatus	6.00 to	8.00
Generators, switchboard, exciters, oil switches for 6,600 volts	13.00 to	20.00
Miscellaneous expense	10.00 to	15.00
Total	$101.00 to	$142.00
Average cost per kilowatt	$121.50	

TABLE II—OPERATING COST OF A GAS-ENGINE POWER PLANT WITH SIX 3,000-KW. UNITS AND ONE 4,000-KW. UNIT

	Cost per Kilowatt-Hour, Cents
Fuel, 1,443,288,000 cu.ft.; average B.t.u., 94 per cu.ft. at $0.0094 per 1,000 cu.ft.	0.00158
Labor, including switchboard operators, engineers, oilers, superintendents, etc.	0.00030
Repairs, including renewals, tools, miscellaneous supplies and labor in repairs	0.00033
Water for cooling, oil, waste, packing and cooling-pond expense	0.00021
Gas cleaning, including water, labor, repairs and power	0.00037
Total operating cost	0.00279
Heating feed water with exhaust gases (installed on four engines only), credit	0.00033
Net operating cost	0.00246

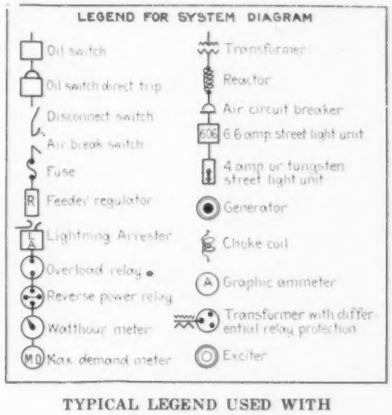
In the matter of operating costs one of the principal items in the past has been the renewal of worn steel parts, such as pistons, cylinders, piston rods, etc. This item has been very materially reduced by the careful application of electric welding. Formerly when the grooves of the piston became worn to such an extent as to cause excessive leakage by the piston ring all that could be done was to remachine them and put on oversized rings. This, of course, could not be carried on indefinitely on account of cutting away the metal. Today the worn places are filled up by electric welding and machined out so that the life of a steel piston is almost infinite. A cast-iron piston cannot be welded.

At times cracks develop in cylinder walls, especially in the vicinity of the exhaust ports. Formerly these cracks would necessitate the scrapping of the cylinder. Today they are welded and seldom open up again; in fact, discarded cylinders have been reclaimed by this process to such an extent in one plant that four extra cylinders which were on order have been canceled. It is seen, therefore, that with the proper application of electric welding a gas engine built of steel should never wear out and would be replaced only because of obsolescence.

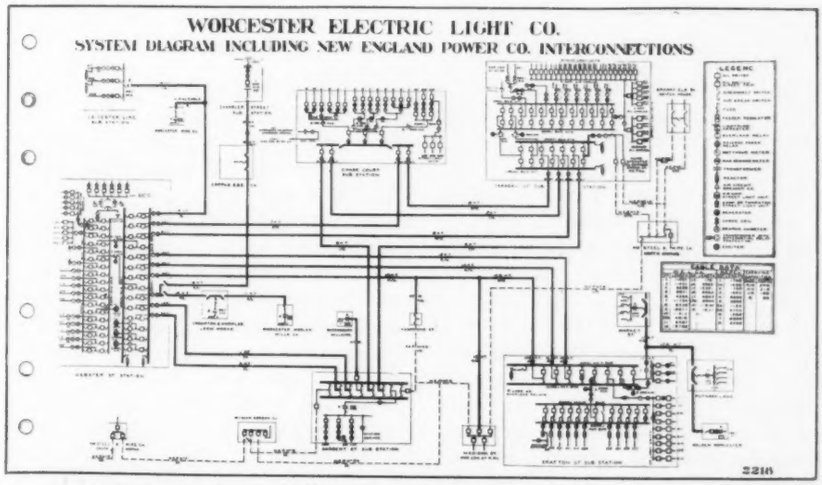
FIELD EDITOR ELECTRICAL WORLD.
Chicago, Ill.

Compact System Diagram for Pocket Binder

A FOLDING single-line diagram about 6 in. x 10 in. in size, printed on cloth-backed paper and punched for a Lefax binder, is issued annually by the Worcester (Mass.) Electric Light Company to operating officials, engineers and maintenance foremen to enable them to keep in close touch with the status of the company's 13,200-volt system. Practically this entire system of higher-voltage lines is now underground, and a useful feature of the diagram is a tabulation of circuit sizes and lengths between the generating plant of the company at Webster Street and the various substations.



TYPICAL LEGEND USED WITH SYSTEM DIAGRAM



ENTIRE SYSTEM OF 13,200-VOLT LINES SHOWN IN 60-SQ.IN. DIAGRAM

Interconnections with the New England Power Company are also shown on the diagram, with the location of oil circuit breakers, disconnecting switches, transformers, reactors, relays, buses, etc., on the central-station system. In emergencies or construction problems these diagrams are a great convenience, and their compactness well illustrates the value of single-line diagrams. Worcester is a city of about 175,000 population, and the rating of Webster Street is about 55,000 kva.

GEORGE M. HARDY,
General Superintendent.
Worcester Electric Light Company,
Worcester, Mass.

Line-Drop Charts Solving 2,300-Volt Problems

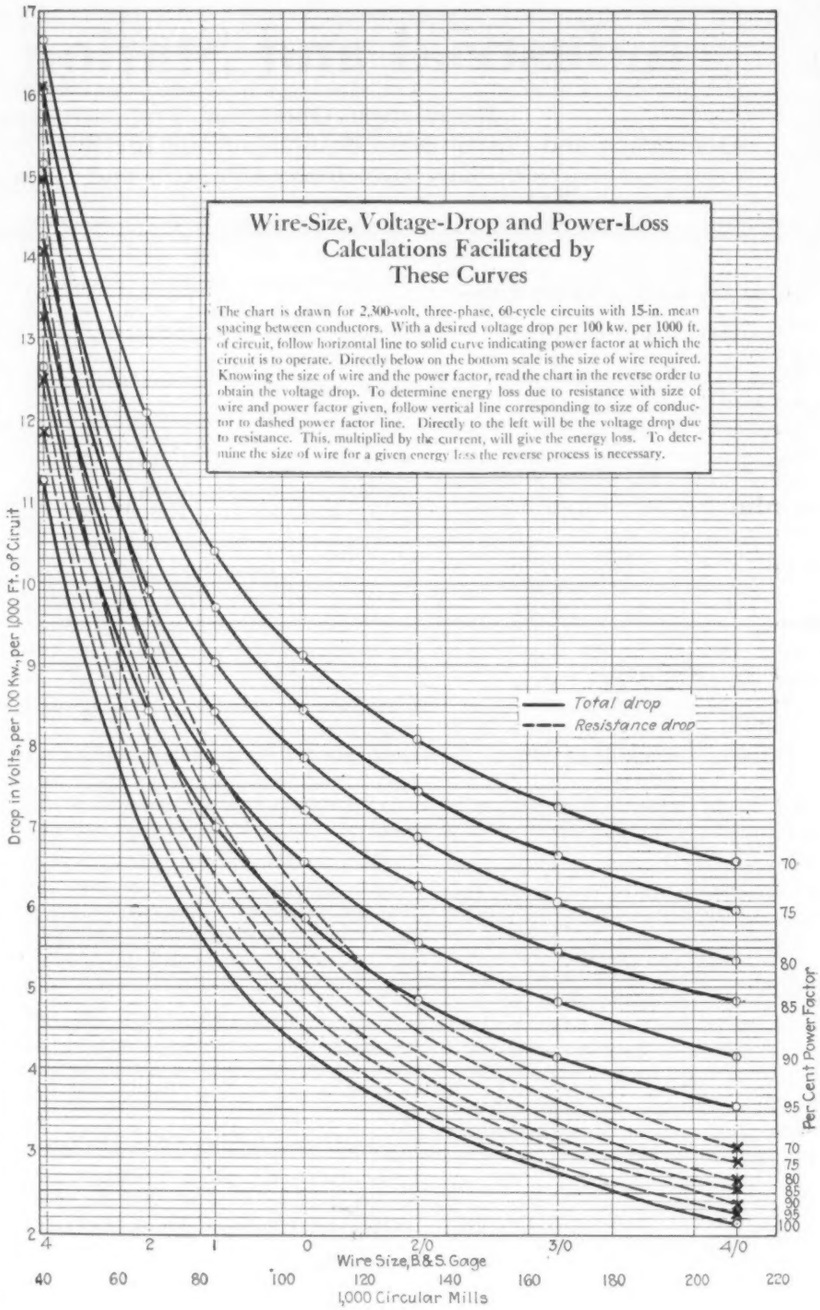
SEVERAL approximate methods for the calculation of transmission and distribution lines have appeared in recent issues of the *Electrical World* covering all the standard voltages in every-day use. However, nearly all electrical companies have only three or four standard voltages, and line-drop charts of the type shown in the accompanying illustration offer a ready solution to every-day problems of wire size, voltage drop and power loss. This chart is for 2,300-volt, three-phase, 60-cycle circuits with 15 in. mean spacing.

In plotting the chart the voltage drop per 100 kw. per 1,000 ft. of circuit for the desired sizes and power factor is calculated by means of a Mershon diagram or by L. A. Herdt's "Chart for the Calculation of Transmission Lines." The latter is more convenient but does not cover wires smaller than No. 2. Capacity has been disregarded.

To find the voltage drop due to resistance only, follow dotted curve corresponding to the power factor of line to its intersection with the vertical through the desired wire size; then follow the horizontal line from this point of intersection to the scale at the left and read the volts drop per 100 kw. per 1,000 ft. of circuit. To find the total drop or that due to both resistance and reactance the full lines are used.

For example: What is the total line drop in transmitting 100 kw. 1,000 ft., three-phase, at 80 per cent power factor, with No. 2 wire?

To solve this: Follow the solid line corresponding to 80 per cent power factor to its intersection with the vertical through No. 2 wire and then follow the horizontal from this point to the scale on the left, which gives 10.53 volts drop. If in the above example single-phase current is used instead of three-phase, the drop will be twice as large, or 21.06 volts. Remembering that load and distance have an equal effect on line drop and losses, the wire size, spacing, frequency, power factor, etc., remaining the same, the chart can be used for solving problems in line drop, wire size, etc.


Wire-Size, Voltage-Drop and Power-Loss Calculations Facilitated by These Curves
The chart is drawn for 2,300-volt, three-phase, 60-cycle circuits with 15-in. mean spacing between conductors. With a desired voltage drop per 100 kw. per 1000 ft. of circuit, follow horizontal line to solid curve indicating power factor at which the circuit is to operate. Directly below on the bottom scale is the size of wire required. Knowing the size of wire and the power factor, read the chart in the reverse order to obtain the voltage drop. To determine energy loss due to resistance with size of wire and power factor given, follow vertical line corresponding to size of conductor to dashed power factor line. Directly to the left will be the voltage drop due to resistance. This, multiplied by the current, will give the energy loss. To determine the size of wire for a given energy loss the reverse process is necessary.
Drop in Volts, per 100 Kw., per 1,000 Ft. of Circuit
Total drop
Resistance drop
Per Cent Power Factor
Wire Size, B & S. Gage
1,000 Circular Mills

From the chart we find that the total drop for 100-kw., 1,000-ft., No. 2 wire, etc., is 8.4 volts. For the conditions of the problem the total drop will be:

$$8.4 \times 300/100 \times 6{,}000/1{,}000 = 8.4 \times 18 = 151 \text{ volts.}$$

From the basis upon which the chart is made a general formula can be deduced:

$$V = d \times \text{kw}/100 \times l/1000$$

where V = final voltage drop.
d = voltage drop per 100 kw. per 1,000 ft. of circuit, read from chart
and l = length of circuit in feet.

Problem 1. Required to determine the voltage drop with a load of 300 kw., three-phase, distance 6,000 ft., 95 per cent power factor and No. 2 wire.

Problem 2. Required to find the wire size where the voltage drop is 10 per cent, or 230 volts, with a load of 140 kw., three-phase, distance 5 miles and power factor 80 per cent. From the above equation the drop per 100 kw. per 1,000 ft. is:

$$230 = d \times 140/100 \times (5 \times 5{,}280)/1{,}000$$

$$d = 230 \div (140/100 \times 5 \times 5{,}280/1{,}000) = 6.2 \text{ volts.}$$

Looking on the chart, we see that this drop corresponds to a No. 3/0 wire.

ROBERT C. SMITH.

Public Service Department,
Glendale, Cal.

Uneven Ice Loading Causes Short Circuit on Line

ABOUT ten years ago we received a trouble call from the load dispatcher on a large hydro-electric system, who said that two 66,000-volt transmission lines were in trouble, the operator being unable to keep them energized. It was found that uneven ice loading on the wires had caused the conductors to come together and short-circuit. Considering the phase wires as *A*, *B* and *C*, from top to bottom respectively it was observed that *A* and *B* each had a deposit of four inches of ice and that *C* had but one inch. This condition was the same for both lines.

As the work of repairing the lines progressed a preliminary report was made to the load dispatcher in which it was stated that *C* and *B* were broken by the ice load and were both lying on the ground, but that *A*, although heavily loaded, remained intact and would need only to have the ice removed before energizing the line.

Since suspension-type insulators were used at this point of the line, which was on the crest of a hill at an elevation of 3,000 ft., *A* and *B*, being equally loaded, drew all the sag from unloaded sections on each side of the trouble zone, and both sagged evenly. As the ice formation of *C* was a great deal less than on the two other wires, when *B* sagged it came into contact with *C*, causing a short circuit and causing each wire to part. Question arose in making out the supplementary report as to the reason for the uneven deposit of ice on the conductors. The answer was that a heavy mist had passed over the mountain top, phases *A* and *B* receiving the full benefit of the dampness, while phase *C* was protected by the trees on the windward side of the right-of-way. Had there been no trees on either side of the right-of-way, or had they been removed during construction, the interruption to service would have been averted. The writer, who inspected this line before placing it in service, recommended that strain insulators should be installed at this point so as to prevent just such an occurrence.

In building transmission lines at high altitudes there are two alternatives: Either use dead-end or strain insulators or widen the right-of-way in places where it may be deemed necessary when passing through wooded sections.

Spencer, Mass. G. S. PHELAN.

Standardization Rules for Electric Drills

WHAT are believed to be the first standards for portable electric drills were adopted by the Electric Power Club on Aug. 20, 1922. These rules are the nucleus of a complete group of electric tool standards and include a definition of what constitutes a portable electric drill, test requirements of the motors, performance specifications for drilling, standard sizes of drills and the information which should be given on electric drill nameplates. Some of the standardization rules are given in the following paragraphs, and they will all be published in the next edition of the Electric Power Club's handbook:

TABLE I—MINIMUM DRILLING REQUIREMENTS OF PORTABLE DRILLS

Twist Drill Diameter, In.	Depth of Drilling per Minute, In.	Twist Drill Diameter, In.	Depth of Drilling per Minute, In.
3/16	1 5/8	7/8	7/8
1/4	1 1/2	29/32	7/8
5/16	1 3/8	1	13/16
3/8	1 5/16	1 1/4	11/16
1/2	1 1/8	1 1/2	5/8
9/16	1 1/16	1 3/4	9/16
5/8	1 1/16	2	1/2
3/4	15/16	.....	.....

TABLE II—TEMPERATURE RISE UNDER NORMAL CONDITIONS

Insulation, class A; load, 100 per cent of rated capacity; time rating, intermittent.

	Temperature Rise, Deg. C.
1. Core and windings:	
a. Fully inclosed motors	55
b. All other types	50
2. Commutators:	
a. If class A insulation is employed in the commutator or is adjacent thereto and its life would be affected by the heat from the commutator	65
b. In all other cases	85
3. Bare copper windings	60
3A. Bare copper windings, inclosed motors: Provided the thermometer is applied directly to the surface of the bare copper winding	65
4. Mechanical parts: Temperature rise of all mechanical parts not in contact with insulation may be such as will not be injurious in any respect.	

Performance Specifications. — The minimum drilling requirements of portable electric drills shall be based on the drilling of holes in 20-30 carbon steel with carbon steel drills of the full rated capacity of the electric drill, at a cutting speed of approximately 50 ft. per minute, and at the specified minimum rate of speed per minute for the various sizes of drills given in Table I.

Temperature Rise. — Temperature rise in degrees centigrade when operating under normal conditions, as specified on the nameplate, shall be as given in Table II.

S. N. CLARKSON,
Executive Secretary.

Electric Power Club,
Cleveland, Ohio.

Safety Cabinets Reduce Fire Hazards

EVEN though the use of the inclosed switch in meter installations is superior to the open type, it does not represent the safest practice, as may be seen from the following paragraphs.

The average practice where inclosed switches are used is as follows: The entrance conduit is installed and connected direct to the inclosed switch; open wires are then connected to this switch and run to the meter, thence to the branch cut-outs, which in the majority of installations are not inclosed. In analyzing these installations four points should be considered:

First, the contractor installs service wires in conduit and runs open wires to the meter. Why not inclose the meter wires?

Second, it is the practice in a good many cities to install any inclosed switch that has been approved by the fire underwriters, irrespective of whether it has sufficient clearance for the utility to test the meter.

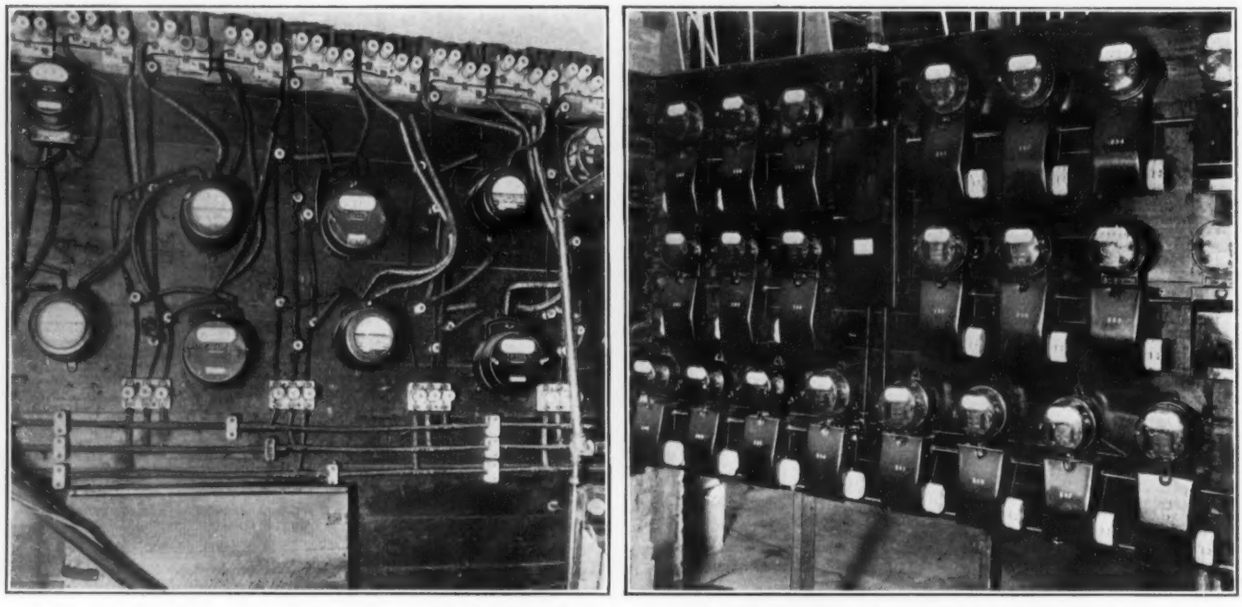
Third, with reference to the average installation, the city electrical inspector and a great many central-station companies are not interested as to whether the switch is sealed and permit the consumer to destroy all of the protection that the city electrical department is endeavoring to give him. From the standpoint of the utility this permits the theft of electrical energy. Now, why should the city electrical department advocate that means be provided to prevent theft? The reason is that the consumer in stealing energy steals from every honest consumer as well as the central station, and in sealing these cabinets the utility is protecting the revenues of all its consumers.

Fourth, a great deal of propaganda has been advanced explaining the danger of the open-knife switch, all of which is a tremendous improvement along safety lines. But if a hazard exists at the switch, why does not a similar condition exist in connection with the branch cut-outs? It is this company's belief that in order to make safe installations the branch cut-outs must be completely inclosed in porcelain or steel.

It has been found by experience that improper use of material in the main-line cut-outs has resulted in fires, and the writer believes that this is one of the greatest electrical hazards that exist today. Sealing these entrance fuses, we believe, results in better protection to our consumers and to ourselves. The present practice seems to be that the electrical inspector, or some one in a position to know the danger, says to the consumer or the contractor, "Please do not plug the fuses as it is dangerous." Is it not a safer and saner method to prevent the tampering of this safety device than to permit the hazard which is considered in a great many localities more or less of a joke? We are advocating the installation of fuses of smaller capacity accessible to the consumer and then, in all cases, the sealing of the entrance fuse. In the majority of trouble cases the smaller fuse will open and can be readily renewed by the consumer; if he then inserts a penny, the main fuses will blow. It would seem that the utility is entitled to know that this has happened so that it can inspect its meter and transforming apparatus, which may become damaged from the short circuit. There was a great deal of discussion a few months ago with reference to electrical fires presumably caused by defective wiring. It is the writer's contention that a fire cannot be started in the ordinary residence installation by actually short-circuting the wiring, provided proper fuses are installed at the entrance service.

The present time is ideal for obtaining "safe and sane" meter installations because the manufacturers and utilities are willing to co-operate. It is the writer's opinion that the safety cabinet should be made by more than one company, which permits the use of the standard end wall and can be produced at a reasonable cost and should be handled through the contractor-dealer in order that an excessive burden shall not be placed upon the consumer. It should be of sufficient dimensions to meet the requirements of the public service company. There is no question that the utilities have a right to make reasonable rules and specifications, especially with reference to installations where they are required to furnish a meter. It is not possible to obtain a 100 per cent safe installation without having the full cooperation of the central station. In reality, the utility should be more interested in the installation of a safety cabinet than the consumer or the contractor, because it is required to furnish proper service through this device and is in most states required by the public service commission to make periodic tests on the meter.

J. C. LANGDELL,
Meter Engineer.
Hodenpyl, Hardy & Company, Inc.,
Jackson, Mich.



COMPACTNESS, SAFETY AND PREVENTION OF THEFT OF ENERGY ARE SOME OF THE RESULTS OBTAINED BY USING SAFETY CABINETS

Left—The fire risk due to the proximity of the gas meter is a horrible example of old-time wiring. Right—Completely inclosing all wiring and mounting customers' fuses in the knockouts practically eliminates all fire hazards.

Effect of Electrode Size on Metal Deposition

THE size of the electrodes used in arc welding should be such that the current in them is about 8,000 amp. per square inch. If the electrodes are too large, the arc is harder to maintain, the rate of deposition is slower, and the penetration is excessive. If the electrodes are too small, they are fused too rapidly, with the result that the metal is deposited before the parent metal is fused, causing poor penetration and large overlap. In extreme cases the electrode may melt and drops fall on the parent metal, causing beading. The proportions between the size of the electrodes and the current density for most successful results on work of average size is 90 amp. to 125 amp. for $\frac{1}{8}$-in. electrodes and 150 amp. to 200 amp. when $\frac{5}{16}$-in. electrodes are used.

D. N. LOUIS.
San José, Cal.

Central Station Business

Advertising, Selling and Service Methods
Commercial Organization and Management, Customer and Trade Relations, Public and Financial Policies, and Reports of Company Plans and Experiences

Power Sales Through Breakdown Service

By Co-operating with Casualty Organizations Central Stations Can Often Gain Permanent Load When Private Power Plants Fail

AN UNDEVELOPED opportunity for increasing central-station power service in industrial plants through closer co-operation with insurance interests was pointed out at the recent New London convention of the New England Division of the N. E. L. A. by R. F. Cavanaugh of the Employers' Liability Assurance Corporation, Ltd., Boston, in an address upon "The Relation Between Industrial Breakdowns and Central-Station Power Development." The speaker emphasized the heavy cost of shutdowns under use-and-occupancy insurance and the importance from all standpoints of resuming productive service as soon as possible. Within the last few years electric motor drive has become extremely reliable, and casualty companies are now willing to write insurance against motor failures and consequent suspension of production. In many cases electrical risks are preferred to risks on mechanical drives from steam engines.

Recently accidents have occurred in industrial plants due to the breakdown of old steam engines. In these cases there is often opportunity for installing partial if not complete electric drive on very short order, and this, of course, reduces losses both to the insurance company and to the plant owner. In one such case at Fall River, Mass., it was possible to save the insurance company $1,800 per day through the rental of 705 hp. in electric motors operated by local central-station service. A temporary condenser was installed in connection with the high-pressure cylinder of a reciprocating engine the low-pressure side of which had failed, and this, with the rented electric power, enabled operations to be resumed in very quick time at the mill.

As industrial steam-power plants depreciate the hazards of operation tend to increase to a point where breakdowns interrupt production, and at such times a well-prepared plan of action on the part of the central-station company brings its own reward.

When boilers reach, say, twenty years of age the steam pressure must be reduced in accordance with state laws. Later many concerns install new boilers designed to operate at higher pressures than were formerly used by the plant equipment, and the resulting strain upon prime movers often leads to accident. "There are a lot of old engines which are playing 'hookey' from the junk pile," said Mr. Cavanaugh, "and when these fail is the psychological time for the central station's power engineer to come to the rescue."

Central-Station Service Does Not Injure the Engineer

One of the chief difficulties in connection with the electrification of an industrial plant by central-station service is the opposition of operating steam engineers in these mills to the purchase of outside energy. Many such engineers are afraid of the entrance of central-station power for fear they may lose their jobs. Mr. Cavanaugh stated that in his ten years' experience in the United States and Canada he had never come across a single case where a competent engineer lost his place because of the introduction of purchased power. Objections by engineers to purchasing energy on the most economical basis brand them as incompetent, and the engineer who objects to outside power coming in is also pretty apt to object to outside inspection of his plant. There are naturally many important tasks for the operating engineer to perform around a plant that has been electrified by central-station service, apart from the time-honored duty of operating and maintaining steam-engine equipment.

Readiness to go to the assistance of industrial plants in case of trouble is a most important phase of obtaining such power business. Mr. Cavanaugh pointed out the value of preliminary analyses of load conditions and ready records showing distances from feeders, the availability of motors for prompt installation, probable course to take in case of a shutdown which can be relieved by running temporary or permanent lines to a plant, and other preparatory steps that the far-sighted central-station power engineer should take if he wishes to obtain this class of business when the opportunity arises.

In some industrial plants the operating engineer suports a policy of piecemeal electrification. Then, when the entire plant is motorized, he goes to his superior with the advice that central-station service be discarded and isolated-plant generating machinery be installed and operated. Central stations can anticipate this sort of a move by studying their loads and striving to furnish the most economical service possible to their customers.

Quick Service Wins Business

When an accident occurs under a use-and-occupancy contract the problem of repairing or replacement immediately comes to the front, and in the interest of getting the plant into operation at the earliest possible moment the question of improvising new parts or installing central-station service is often a live issue. The company has found it saves time in most cases to make up new engine parts, castings, etc., in local machine shops or foundries, as compared with waiting for the builders to supply the missing elements. Where local resources are available a plant can often be got into operation in a week or much less. Here the central station which is prepared promptly to introduce service after equipment failure stands a far better chance of securing additional power busi-

ness than one which has allowed matters to drift along without preliminary workable plans for running lines into such a plant.

Accidents to equipment are classified under defective material, poor design and faulty management, the last-named being the greatest hazard. Some industries fear that if large motor units are installed by a central station breakdowns will result in heavy losses from the productive standpoint, but the speaker said that he knew of no case where an entire large industry had been shut down by the failure of central-station power. Utility companies carry adequate reserves in general, and interconnections between utilities and between these and industrial plants are helping to maintain service reliability.

CULTIVATE BETTER UNDERSTANDING

Central-station officials should address the organizations of operating engineers as to public policies, economics of utility service and stability of employment. In this way progress will be less retarded by the obstructions put in the way of utility service by engineers of stationary power plants. Power companies should be ready to extend their lines for the complete electrification of industrial plants with guarantee of permanent service. The casualty engineer stands ready to co-operate with the utility in this direction.

C. B. Burleigh, General Electric Company, Boston, declared that every central-station company of any magnitude should be represented in the membership of the National Association of Stationary Engineers, in order that the ideas of utilities may be spread among the individuals of that organization. This should be done, he said, even if the central-station company pays the dues of its representative.

Great Benefit If Number of Demand Rates Is Reduced

THAT entirely too great a diversity exists in demand rates was emphasized in the report of the committee on this subject, F. W. Smith chairman, at the Lake Placid meeting of the Empire State Gas & Electric Association. Greater uniformity is necessary, although no definite conclusions were given. As a result of the survey which stimulated this observation it was found that several questions arose. For example, should demand charges be on a monthly or yearly basis? Should they be based on yearly, monthly or weekly peaks? Should they apply to the calendar or the contract year? And when should different demand intervals be used? In this connection attention was called to the bearing which load factor and diversity factor have on the interval to select. It was pointed out that demand meter development would be greatly hastened by more uniform practice.

Emphasizing this point, J. T. Hutchings declared that the diversity of demand intervals makes instruments costly, development expensive, stock more costly to keep and deliveries more difficult than if there were fewer demand intervals used. Two or three intervals should be adopted, he contended. Because of their smaller effect on the service system, small consumers are entitled to longer demand intervals than large companies. Steam-plant service, which can be used to handle fluctuating loads, should be rendered on a short-interval basis, whereas water-power plants can sell on long-interval basis.

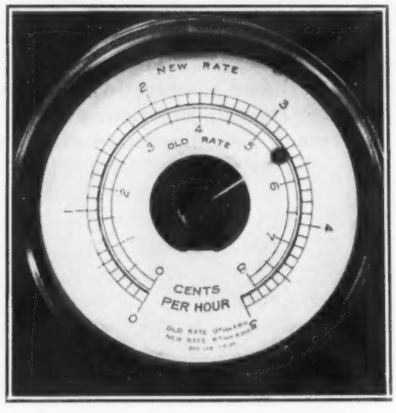
The chief trouble with demand instruments, declared E. P. Peck, is their improper functioning. He maintained that the problem of bringing about the use of fewer demand intervals would be greatly facilitated by the collection of data comparing the registration of different demand meters with different demand intervals on various types of loads—fluctuating and uniform. It will probably be found that the difference is not great and that one interval can be used for fluctuating or intermittent loads and another for average loads.

Mr. Peck also raised the question: "Are we measuring the right demand?" In his opinion kilovolt-ampere demand and not kilowatt-demand is the important factor, since its purpose is to determine the portion of the standby equipment which must be kept in readiness. A study of the relative effects of kva. demand on different parts of a system would, Mr. Peck thought, be very enlightening.

The important problem, said C. G. M. Thomas, is how demand shall be determined. Whatever the method, service must be rendered on a basis that will be attractive to the customer and profitable to the company. Rates or minimum guarantees must never be established to attract business.

Demonstrating New Rates in Appliance Department

SINCE establishing a reduced rate for electricity early this year the Hartford (Conn.) Electric Light Company has sought to capitalize the reduction by means of various window displays, advertisements, etc., some of which have been illustrated in the *Electrical World*. Recently an indicating wattmeter showing the cost of operating appliances per hour on both old and new rates has been installed on the appliance exchange



EACH READING OF METER CONTRASTS OLD AND NEW RATES

floor of the company's main office, and this has proved effective in interesting visitors in the lowered costs of service. In the illustrated view shown the hourly cost of operating an electric radiator of recent design with the old and the new rates is indicated.

Public Utility Safety Work in Public Schools

COURSES of study in safety are receiving increasing attention in the public schools, and in many cases utility companies have interested themselves directly in the courses and taken an active part in conducting the work. Comparatively little has as yet been done toward preparing a textbook on this subject, and most of the effort has been confined to talks and illustrations calculated to reach the children.

Definite action is being taken in some cities toward the formulation of logical courses of study that will become a part of the school routine.

Typical of this sort of work is that done in Toledo, where the school authorities are co-operating with the

Community Traction Company, the Toledo Edison Company and the Toledo Automobile Club. A course of study outline has been prepared which covers eight headings. These are: "How to Avoid Accidents in School," "How to Make the Common Experiences of the Street Safe," "Safety in the Home," "A Study of Fires in the Home," "Ways in Which People Are Burned," "How Can Fires Be Prevented," "Other Forms of Accidents or Unsafe Conditions in the Home," and "How to Prevent Accidents in Public Places."

Some material regarding the dangers of defective wiring and ways in which electric appliances can be misused and create fire hazards is included. In addition to the outline for safety studies an outline of methods of presentation to the primary, middle and upper grades is given in very complete form. In the course in Toledo the subject of electrical hazards is not overemphasized but is included as a part of the general subject. Public utilities, particularly the central-station and electric railway companies, are taking active part in the promotion of such work in the public schools in a number of places. Among the notable movements to include safety in the course of study is that in Chicago, where a complete textbook for use in the city schools is being prepared and it is expected that it will be used actively during the present year.

An Effective "Contrast" Window

AN EFFECTIVE "contrast window" designed to exhibit old and new methods of house cleaning was recently featured by the Worcester (Mass.) Electric Light Company under the direction of O. R. Underhill, superintendent of the appliance department. The accompanying photograph shows how the company's window space was used to tell the story to passers-by.

A WORCESTER WINDOW THAT TOLD THE STORY OF ELECTRIC CLEANING

Courteous Service Mark of Notice to Customers

By A. C. McMICKEN

Sales Manager Portland Railway, Light & Power Company, Portland, Ore.

IN ITS campaign to impress the public with the fact that service and courtesy are the prime motives of the power company, the Portland Railway, Light & Power Company has made a simple change in the wording of cards which are left on the premises of new tenants by the company's inspectors. This company follows the practice of leaving the service connected when a tenant moves out, in order to save the new occupant the inconvenience of being without lights for several days. When the meter reader on his regular monthly rounds finds the premises unoccupied and consumption shown on the meter since the final reading of the previous tenant, he notifies the commercial department and an inspector calls and leaves a card which reads:

Our electric service has been left connected, ready to use, for your convenience. No one likes to wait for the electricity to be connected—particularly after "moving in." Will you not help us by telephoning our commercial department within the next five days whether or not you desire the electric service left connected or call at our office and sign the necessary application? We will gladly send a representative for your application if it is not convenient for you to call at our office. Just use the telephone. If you do not telephone our commercial department or call in person within the next five days, we shall understand that you do not want electric service and will disconnect same without further notice.

The card formerly in use frequently created a wrong impression as the wording was decidedly terse and carried a certain note of command. It read:

In order to save you the inconvenience of an interruption in service, we are leaving your electric lights temporarily connected, with the understanding that within the next five days you will call at our office and sign the required application for service.

If the above conditions are not complied with, we shall be obliged to discontinue service without further notice.

In the redrafted notice the idea of convenience and service has been emphasized, and the customer is made to feel that the company's first desire is to render courteous service.

What Other Companies Are Doing

Ohio.—Two more municipal electric light plants in this state have kicked the proverbial bucket. In Blanchester residents of the village voted four to one to abandon their municipal plant because it was proving too costly a proposition. Energy will be purchased from a privately owned plant. "Expenditures exceeded the income," says the village clerk of Williamsburg in explaining why the municipal plant has been sold and will be operated by a private company.

Utah. — Approximately 95 per cent of all homes in this state within 300 ft. of distribution lines are wired and have electric service. How this has influenced the sale of electric appliances is shown by the following figures: In Utah there are now being used 4,200 ranges, 20,000 washing machines, 60,000 flatirons, 7,500 vacuum cleaners, 1,500 sewing machines, 85 bake ovens and 20,000 other electrical devices such as grills, toasters, percolators and miscellaneous items.

Portland, Ore.—With a total twenty-four-hour generation of 1,028,000 kw.-hr. on Sept. 20, the Portland Railway Light & Power Company broke all former records. The daily generation is now 20 per cent above that of a year ago. As the winter peak is still three months ahead, it is expected that records will continue to be smashed. Unfortunately the fall rains have been delayed and the mountain streams feeding the hydro-electric plants are at extreme low levels. This has taxed the steam plants to capacity.

Digest of Electrical Literature

Including Brief Abstracts of and References to
Important Articles Appearing in the Scientific and Engineering Press
from All Parts of the World

Hydro-Electric Development and Steam Equipment

The Power Plant in a Modern Sugar Refinery.—ROGER B. STEVENS.—The factors determining the selection of prime movers and the relative advantages and disadvantages of direct-current and alternating-current equipment as applied in the American Sugar Refinery Company of Baltimore are pointed out. After an exhaustive investigation reciprocating engines as prime movers were selected. The chief reason for this choice was that a large part of the steam generated in the plant is expended in closed-coil heaters immersed directly in the sugar solution, and upon the development of a slight leak in any one coil sugar is allowed to g into the boiler water, where, under the influence of heat, it breaks down and forms complex organic acids. These acids, or in some cases the excessive amount of boiler compound which is introduced to neutralize them, are the cause of much deterioration of turbine blades.—*Power*, Sept. 19, 1922.

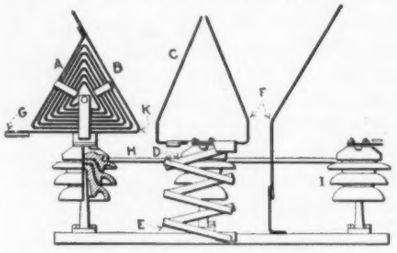
The Hydraulic Turbine in Evolution. —H. B. TAYLOR and L. F. MOODY.—Notable work has been accomplished in the extension of the range of available speeds, so that extremely high specific speeds are now obtainable with satisfactory efficiency. The authors describe some of the lines of development which have been followed and some of the problems involved in applying the new turbine forms. — *Mechanical Engineering*, October, 1921.

Great Falls Development of Manitoba Power Company.—F. H. MARTIN.—An ultimate development of 168,000 hp. is planned for this section of the Winnipeg River. The power house is being built for an initial installation of three 28,000-hp. units operating under a 56-ft head. Concrete centercone draft tubes are to be used. Three-phase, 60-cycle, 11,000-volt, 138.5-r.p.m. generators are provided with 150-kw. direct-connected exciters. A résumé is given of the governors, draft tubes, transformers, thrust bearings and switching equipment. — *Canadian Engineer*, Sept. 12, 1922.

Generation, Control and Switching

Transient Phenomena in a Short-Circuited Alternator.—TARO OTAKE.—A study starting with the generally accepted fundamental equations for a short-circuited alternator and using no questionable assumptions. The solution of these is effected by means of an integral equation, and the results thus obtained are compared with other studies made on this problem.—*Journal of the Institute of Electrical Engineers of Japan*, September, 1922.

High-Voltage Switchgear Developments.—W. A. COATES.—The previous experience of American and European engineers in high-voltage transmission is being used to advantage by English engineers who are just facing this problem. High-voltage switchgear in Continental plants has up to the present been placed indoors, while even the earliest American practice embraced the use of outdoor structures. The most important item in outdoor construction is the oil circuit breaker. The form of lightning arrester shown in the accompanying illustration, which has been widely used in America, is beginning to be used in Englinad.—*Engineer*, Aug. 25, 1922.



HORN ARRESTER FINDING FAVOR IN ENGLAND

In this arrester any impulse coming from the line enters at *G* and, meeting its first impedance at the upward turn *K*, flashes over to the ground horn. A high-frequency discharge will prefer to take the lower resistance path through both main gap *K* and auxiliary gap *F*, while at lower frequencies the path selected would be through the main gap *K* and the resistances *D*, the latter limiting the possible flow of dynamic current.

Transmission, Substations and Distribution

Aspects of the Most Economical Transmission-Line Design. — WILLIAM T. TAYLOR.—In designing a transmission line, the principal independent variables to be taken into account are distance, amount and nature of load, cost of generating energy, spacing of poles or towers, voltage and spacing of conductors. After discussing the various factors that must be considered, the author outlines the steps that must be taken to determine the most economical line.—*Electrical Review*, Sept. 1, 1922.

Steel-Aluminum Overhead Lines. — H. SCHENKEL. — Basing his study on theoretical considerations, the author explains how the stresses due to changes in temperature are distributed between the two metals in a steel-aluminum cable. It is impossible to support such a cable so as to avoid all stresses under all conditions in the aluminum. The calculations show that by proper dimensioning of a bimetallic cable a smaller sag may be obtained and higher towers may be used than with an equivalent copper cable. — *Elektrotechnische Zeitschrift*, Sept. 14, 1922.

Noiseless Automatic Substation for Los Angeles Railway. — CLARK E. BAKER. — The Los Angeles Railway Corporation has solved the problem of building substations in the residential part of the city in a satisfactory manner by utilizing automatic substation equipment housed in an ingeniously constructed sound-proof building of architectural beauty.—*General Electric Review*, October, 1922.

Units, Measurements and Instruments

Direct Reading and Computing Attachment for Sphere Photometers. — B. S. WILLIS.—A very ingenious mechanical arrangement for obtaining direct readings from integrating spheres is described. The device, which was developed by the Bureau of Standards, converts into logarithmic motion the inverse square motion of the comparison lamp of the sphere photometer. Tests show that it has a high degree of precision.—*I. E. S. paper, Swampscott, Mass., Sept.* 25-28, 1922.

Differential Ionometer for the Measurement of Dust in the Air. — H. GREINACHER.—The author has devised an apparatus for the measurement of the ionization of air by X-rays or radium rays and developed formulas for the sensitiveness and the time of indication of the apparatus. An elaborate theoretical analysis of the instrument is given.—*Bulletin of Association Suisse des Electriciens*, August, 1922.

Carbon-Dioxide Meter. — M. WALDHAUSEN.—An entirely new principle is used in the apparatus described in this paper. A small motor pumps the flue gases into a measuring chamber and rotates the same rapidly. Within the chamber is a measuring wheel which is taken along by friction. Air is pumped at the same time into a second identical chamber, with a measuring wheel, but rotated in the reverse direction. The respective rotations of the two wheels oppose each other, and any difference between their torque can be indicated, reading, after proper calibration, directly in per cent of carbon dioxide.—*A. E. G. Mitteilungen*, August, 1922.

Proper Handling, Care and Testing of Insulating Oils.—Nearly all transformers, compensators and oil switches that are used for lighting, power, etc., employ an insulating oil of some grade or other. According to a committee report made at the Huntington convention of the West Virginia-Kentucky Association of Mine, Mechanical and Electrical Engineers, Sept. 22, special mineral oils of high insulating value, free from acid, alkali and moisture, are used. The danger from absorption of moisture and the formation of sludge

can be avoided by testing the transformer oil samples twice a year.—*Coal Age*, Sept. 28, 1922.

Illumination

Lighting the Motion-Picture Studio.—F. F. MILLS.—Lighting requirements for the motion-picture studio are visualized by the author, who points out the field of various illuminants. High-intensity arc lamps are used for special effects, mercury-vapor lamps for general actinic lighting and the high wattage tungsten-filament gas-filled lamps fill their individual place in this industry.—*I. E. S. paper, Swampscott, Mass.*, Sept. 25-28, 1922.

Skylight Illumination on horizontal and Vertical Surfaces.—Sky brightness and daylight illumination measurements were summarized in a report by the committee on sky brightness, H. H. Kimball chairman, at the annual convention of the I. E. S. The measurements were taken in Washington and Chicago during the year ended April 6, 1922. With the sun at different altitudes the intensity for horizontal and vertical surfaces over eight points of the compass was found.—*I. E. S. paper, Swampscott, Mass.*, Sept. 25-28, 1922.

Heat Applications and Material Handling

Manufacture of Carbon Bisulphide.—G. A. RICHTER.—A comparatively recent process is described for the manufacture of carbon bisulphide in an electric furnace. Actual plant data indicate that these furnace units operate with a reasonably fair thermal efficiency. An approximation of the thermal losses is included.—*American Electrochemical Society paper, Montreal*, Sept. 21, 1922.

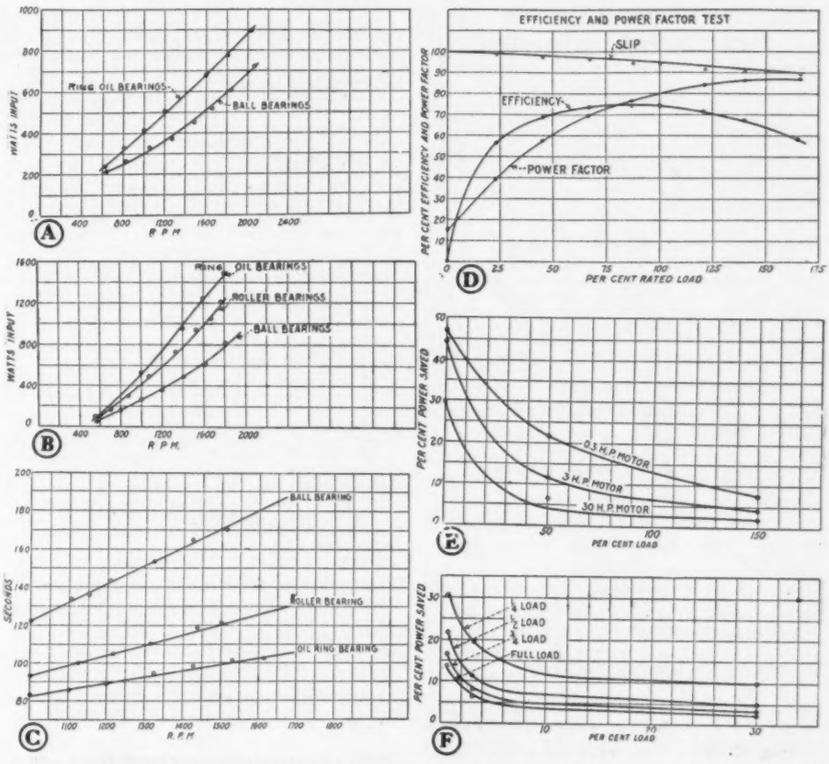
Progress of Electric Welding Processes.—O. WUNDRAM.—A review is given of the development of the arc-welding and resistance-welding methods. It is claimed that too much attention has been paid to the development of special welding generators and transformers with a deplorable lack of research into the welding process itself. Detailed data are needed about the exact current and voltage requirements, the nature of the metal transportation in the arc, the physical and chemical changes of the welded metals, the effect of different fluxes, etc. The latest chemical methods, the microscope and the X-ray should aid in such investigations.—*Elektrische Kraftbetriebe und Bahnen*, Aug. 22, 1922.

Bread-Baking Ovens with Fuel and Electric Heating.—F. GRAF.—Large baking ovens are described which can be heated at will by coal or other fuel or by electric heating units. Most of the ovens were equipped with the second heat supply after they had been installed, and in every case the alteration was done without interruption. The electric capacity of these ovens varies between 3 kw. and 5 kw. per square meter of baking surface. The energy consumed in these ovens amounts to about 0.5 kw.-hr. to 1 kw.-hr. per 1 kg. of bread.—*Bulletin Association Suisse des Electriciens*, August, 1922.

The Electric Range.—F. H. MCCORMICK.—The advantages of the electric range to the household user and to the power supply company are outlined, and a description is given of the manually controlled range, the range which is automatic with respect to temperature control and the range which is super-automatic with respect to both time and temperature control.—*General Electric Review*, August, 1922.

Motors and Control

Ball and Roller Bearings.—G. A. VAN BRUNT.—By properly aligning shafting and providing the bearings and pulleys best suited to the requirements of the machines driven, a marked saving in friction-load shafting installations can be effected. Various designs of ball and roller bearings are described and directions given for installing them on lineshafts and machines. Many illustrations of typical installations are included and the accompanying curves are reproduced to show the comparative tests made on motors equipped with different types of bearings.—*Industrial Engineer*, September, 1922.



COMPARATIVE TESTS ON MOTORS EQUIPPED WITH PLAIN, ROLLER AND BALL BEARINGS

A—Two identical motors except as regards bearings, each driven separately by a third motor. The input represents the windage and friction losses of both driven and driving motors. The difference in the losses represents the saving in power with ball bearings.

B—Windage and friction losses on three motors of similar rating and identical except for the bearings.

C—Curves obtained from the three motors used in B to determine the number of seconds each rotated after the power was cut off.

D—Efficiency and power factor tests made on a 1-hp. ball-bearing induction motor.

E—Percentage of power saved through the use of ball bearings as compared with plain bearings.

F—Saving in power which may be expected with any motor up to 30 hp. equipped with ball bearings instead of plain bearings.

Electrophysics, Electrochemistry and Batteries

Waterproofing by Electricity.—In the perfected type of machine used for waterproofing silk and woolen fabrics two sets of electrodes are employed, the cloth being caused to reverse in the interval between the two electrodes so that both the top and the bottom of the cloth receive a waterproofing treatment. For cotton material four sets of electrodes are used, the cloth being reversed between each set. The method of applying the waterproofing material electrically is described.—*Electrical Times*, Sept. 14, 1922.

The Effect of Impurities in Nickel Salts Used for Electrodeposition.—M. R. THOMPSON and C. T. THOMAS.—Investigations were conducted by the authors to determine the effect of the principal impurities present in nickel salts upon the character of the deposited nickel. It was found that of the impurities likely to be present copper and zinc are especially objectionable. Analyses were made of a considerable number of samples of commercial salts, and specifications for the purity of these materials are suggested.—*American Electrochemical Society paper, Montreal*, Sept. 21, 1922.

Scientific and Industrial Research

A Department Devoted to Reports of Investigations Contemplated or Completed, Research Facilities Available and Suggestions for Co-operative Work

Conducted by PROF. VLADIMIR KARAPETOFF, *Cornell University, Ithaca, N. Y.*

[PRINTED IN THE THIRD ISSUE OF EACH MONTH]

[When investigations which have been completed are, in the opinion of the editors, of wide enough interest to the field we serve, details thereof will be presented in other parts of this paper. Contemplated research or that which appears to have limited appeal will be only briefly reported in this section, but details may be had by communicating with the investigator or institution named in the report. Readers are referred to the department "Digest of Electrical Literature" for investigations reported in other journals. The news and engineering sections should also be followed for research reported before technical societies.]

Research Completed

Arc, Carbon, Temperature of.

By using rotatory dispersion through Nicol prisms, data obtained upon the crater of the carbon arc indicate a color temperature of about 3,780 deg. K. for solid carbons and 3,420 deg. K. for cored carbons.—*Irwin G. Priest, Bureau of Standards, Washington, D. C.*

Alternators, Short-Circuit Tests on.

In some severe short-circuit tests on large alternators a mechanical recording arrangement was attached to the free ends of the stator coils for ascertaining any possible deformations or displacements. On the field coil of one of the pole pieces strips of paper were pasted, partly stretched and partly loose, in order to find out if there were any mechanical results of a sudden short circuit. No measurable deformations were found anywhere.—*F. Wuethrich, Baden, Switzerland.*

Capacitance or Inductance, Extremely Small, Measurement of.

With a hot-cathode Braun tube it is possible to determine very small deviations in frequency. Changes in a capacitance or inductance may be made proportional to those in a standard frequency, and thus measured. Theoretically, a change of inductance of the order of one part in 10^8 can be detected.—*H. G. Tasker and L. T. Jones, University of California, Berkeley, Cal.*

Dynamometer, Electric, for Testing Chassis.

The well-known electric dynamometer has been applied to testing automobile engines assembled on the chassis. The rear wheels of the car stand on and drive the traction drums of the dynamometer, while the car itself is held stationary by being attached to an anchor. The dynamometer can be regulated from the driver's seat.—*Sprague Electric Works, New York City.*

Frequency, Measurement of, by Hot-Cathode Braun Tube.

Two oscillating circuits are made to deflect a cathode beam in two directions at right angles to each other. The combined deflections produce one of the well-known Lissajous figures. If the two circuits are of exactly the same frequency, say 500,000 cycles, the resulting figure will in general be an ellipse. A frequency change of 5 cycles per second will cause the ellipse to revolve five times per second.—*L. M. Hull, Bureau of Standards, Washington, D. C.*

Instruments, Recording, Damping of.

In recording instruments in which oil is used for damping the character of the record may be modified at will by changing the viscosity of the oil. Tests were made on two identical wattmeters connected to a rapidly fluctuating load. One, filled with very light oil gave a record showing minute fluctuations of the load; the other, filled with the heaviest cylinder oil, gave only general variations of the average load. Careful planimetering of the two curves showed the areas to be equal.—*J. W. Esterline, Indianapolis, Ind.*

Mercury Rectifier, High-Tension, High-Power.

A large mercury rectifier was recently built and operated continually at 5,400 volts, 300 amp. (1,620 kw.). It worked without a mishap for a long time, during which tests were made on switching, overloads, short circuits, etc. This type of rectifier should prove useful for automatic substations in the coming extensive electrification of steam railroads.—*Brown, Boveri & Company, Baden, Switzerland.*

Motors, Direct-Current, Synchronous Running of.

In some industrial applications two or more identical shunt-wound direct-current motors must be run in parallel at exactly the same speed. This can be accomplished by providing each armature with three taps connected to slip rings, as in a rotary converter. The corresponding alternating-current brushes of the two machines are connected together. Actual tests have shown that the motors are then forced to run at exactly the same speed because of synchronizing currents. The motor fields can be provided with compound windings; the series coils of motor 1 are connected in series with the armature of motor 2, and vice versa. A similar arrangement works satisfactorily with two motors in series. A one-to-one ratio transformer is used between the two machines on the alternating-current side.—*Cladius Shenfer, Technical High School, Moscow, Russia.*

Nitric Oxides and Ozone, Production of.

An extended investigation has been made of the various factors which enter into the production of oxides of nitrogen and ozone, during corona discharge, particularly with the view of securing higher concentrations of the above products and higher yields per kilowatt-hour. Various types of tubes in which electrical discharges are confined have been tested. For details see Bulletin No. 9 of our Engineering Experiment Station.—*K. B. McEachron, Purdue University, Lafayette, Ind.*

Quartz Lamp, Silica-to-Metal Joint for.

In order to obtain a vacuum-tight quartz-to-metal seal which can stand relatively high temperatures, a homogeneous graded joint has been developed in which fused quartz is connected through intermediate steps of glasses of increasing coefficients of expansion to a glass fused directly to a metal lead-in wire.—*L. J. Buttolph, Hoboken, N. J.*

Sound Intensity, Measurement of.

An electrostatic transmitter combined with a vacuum-tube amplifier is well adapted for the measurement of intensities of complex tones and for use with an oscillograph for recording sound waves. The arrangement can be made either uniformly sensitive over a wide range of frequencies or highly selective for a definite pitch. For details see *Physical Review*, Vol. 19, 1922, page 498.—*E. C. Wente, New York City.*

Ultra-Violet Arc for Testing Materials.

A mercury-arc lamp in a fused-quartz chamber, with suitable filters, has been developed as a source of powerful ultra-violet rays. This lamp has been applied to the testing of dyes, inks, textiles, leather, paints, paper, rubber, etc., for the fading or deteriorating effect of sunlight. Because of the intensity of ultra-violet rays in the arc, a rate of fading which would require about thirty days of June sunlight can be accomplished in a single working day. This light causes fluorescence of some substances and can be used for many practical tests. Thus certain paint pigments instantly show their instability by a visible fluorescence. Fraudulent work and alterations in paintings or manuscripts are easily detected by the dissimilar fluorescence. In the reduction of zinc ores a brilliant fluorescence of the residual willemite in the tailings indicates the amount unextracted.—*L. J. Buttolph, Hoboken, N. J.*

Watt-Hour Meters, Effect of Unsymmetrical Current Wave on.

Four typical commercial induction-type watt-hour meters have been investigated to determine the effect of a load with a symmetrical emf. wave but a non-symmetrical current wave. The meters were tested (1) at three voltages and at unity power factor and (2) at three power factors at the normal voltage, each test for six current values. In no case did the error exceed usual commercial limits, and the greatest observed difference due to changing the load from symmetrical to unsymmetrical was about 2 per cent. At very light loads a somewhat greater variation was observed. A 6-amp. "tungar" rectifier was used to obtain non-symmetrical current waves.—*W. F. Davidson, University of Michigan, Ann Arbor, Mich.*

Suggestions for Research

Cables, Copper, Elasticity of.

It is desired to investigate the effective modulus of elasticity of copper in the form of a standard cable, as compared with a solid conductor of same cross-section. This value is important in determining the stress developed in an overhead cable.—*M. G. Lloyd, Bureau of Standards, Washington, D. C.*

Cables, Insulation of, Represented by Equivalent Leaky Condensers.

For purposes of computation an imperfect cable insulation may be replaced by a perfect condenser shunted by a high resistance. For a more detailed study of the internal phenomena in the insulation it seems better to replace it by two or more leaky condensers in various combinations. A beginning of such a study will be found in a paper by DelMar and Hanson, *A. I. E. E. Journal*, 1922, page 439. Other combinations of leaky condensers should be tried and the results checked on flat samples of impregnated paper and on actual cables.

Furnace, Arc, for Melting Gray Iron.

One of the most promising fields for the electric furnace is where strong gray castings of thin section are required. The sulphur content in scrap iron is often too high to permit of satisfactory thin-section castings being poured from the cupola.—*B. C. Gibson and E. L. Crosby in the N. E. L. A. Bulletin.*

Hysteresis Loop.

While the general hysteresis loop is known, very little is known about the way in which a loop changes with frequency or when one or more of the required harmonics to support it are missing.—*F. S. Dellenbaugh, Jr., Massachusetts Institute of Technology, Cambridge, Mass.*

Insulators, Wet Flashover Test of.

Some recent German tests (*Electrical World*, Sept. 23, page 674) indicate large differences in the flashover voltage, depending upon the conductivity of water used. Systematic tests should be made to determine the quantitative relationship between the two. Either water of standard conductivity should be specified for wet tests on insulators or else a curve should be agreed upon for correction to some agreed standard conductivity of water.

Tanning of Hides by Electricity.

It is imperative that some means be found whereby extract tanning processes for hides can be accelerated, because the amount of capital invested in pelts laid away to tan is far greater today than in times previous. So-called electric tanning, possibly through an adaption of the phenomenon of electric osmose, may eventually solve this problem. Electric tanning processes of this nature have been experimented with in Germany and England of late, and a considerable degree of success has been attained.—*W. E. Broughton and J. J. Brophy, in the A. I. E. E. Journal, September*, 1922.

Watt-Hour-Meter Jewels, Oil for.

Actual tests show that fish oils do not merit confidence for lubricating pivots of watt-hour meters since organic acids are formed in contact with air and brass which attack brass and nickel. Iron oxide of high abrasive properties is also formed, allowing the pivot to grind the jewel. It is believed that more satisfactory oils of petroleum or asphaltic base are available.—*F. C. Holtz, Springfield, Ill.*

News of the Industry

Chronicle of Important Events and General Activities, Announcements and Reports of Association Meetings, Court Decisions and Commission Rulings and News of Electrical Men

Stratton Head of M. I. T.

Praising Him, Secretary Hoover Deplores the Inadequacy of Government Emoluments

DR. S. W. STRATTON, head of the United States Bureau of Standards, Washington, was elected president of the Massachusetts Institute of Technology on Oct. 11 at a meeting of the corporation and will assume office at Cambridge on Jan. 1, 1923.

In connection with Dr. Stratton's election Secretary Hoover of the Department of Commerce gave out the following statement:

"The loss of Dr. Stratton as head of the Bureau of Standards is a real national loss. He has built up that service from a bureau devoted to scientific determination of weights and measurements to a great physical laboratory co-operating with American industry and commerce in the solution of many problems of enormous value to industry which the commercial laboratories of the country, from lack of equipment and personnel, have been unable to undertake.

"While the Massachusetts Institute of Technology is to be congratulated on securing Dr. Stratton, one cannot overlook the fact that the desperately poor pay which our government gives to great experts makes it impossible for us to retain men capable of performing the tasks which are placed upon them.

"The Massachusetts Institute of Technology, an educational institution, finds no difficulty in paying a man of Dr. Stratton's caliber three times the salary the government is able to pay him.

"Dr. Stratton has repeatedly refused large offers before, but the inability of the scientific men in the government to support themselves and their families properly under the living conditions in Washington, and to make any provision for old age, makes it impossible for any responsible department head to obtain such men for public service at government salaries."

Work Begun on Illinois Plant to Cost $12,000,000

The Middle West Power Company, a subsidiary of the Middle West Utilities Company, announces that ground has been broken for its new plant on the east bank of the Mississippi River at Grand Tower, Jackson County, in the southern Illinois coal fields. Building plans call for a total generating capacity of 100,000 kw., representing an ultimate investment of $12,000,000, with provision for still further extension in the future. The first unit to be installed will be rated at 25,000 kw., and there will be room for another unit of this size in the section of the station first completed, which will be of the highest type of modern construction. The turbine, boilers, stokers and other equipment for the first unit have been contracted for, and the plant is expected to be in operation early in the fall of next year.

The Grand Tower plant will furnish electrical energy to another Middle West Utilities Company subsidiary, the Central Illinois Public Service Company, which serves 187 central and southern Illinois cities and towns and has a plant at Muddy, near Harrisburg, Ill. The two plants will be tied together by a 66,000-volt steel-tower transmission line, thus insuring continuous service to the bituminous fields which lie between them.

Will Not Rehear Loop Case

Wisconsin Supreme Court Reaffirms Its Finding in Eau Claire Suit Against Unit Charges

THAT municipalities must be treated as separate units by the Wisconsin Railroad Commission in making electric rates was reiterated by the Wisconsin Supreme Court last week in denying the motion of the state for a rehearing in the case of the city of Eau Claire against the commission. Unless a change in the statute is made by the Legislature, the commission will be required to rearrange the schedule of charges of virtually all electric utility companies in the state as a result of the Supreme Court's decision.

In a recent order the Railroad Commission fixed one rate on electric service for the cities of Eau Claire, Menomonie and Chippewa Falls, all supplied by the Wisconsin-Minnesota Light & Power Company and forming part of the territory served by the company's "loop" system. The city of Eau Claire appealed to the Supreme Court from the commission's ruling, contending that the state board could not legally fix a uniform charge for utility service for a whole district in one order. When the case came before the Supreme Court in July it held the commission's action to be illegal on the ground that it had no power to make equal rates where the expense of service differed. (See *Electrical World* for July 29, page 219.)

Shoals Lease Renewed

Government Plant Will Be Operated by Alabama Power Company for Another Year

RENEWAL for another year of the lease under which the Alabama Power Company operates the government's steam-electric plant at Muscle Shoals, Ala., has been announced by Secretary Weeks. The company will pay the government the same rental as heretofore, amounting to $10,000 a month for the use of the plant, plus a charge of 2 mills a kilowatt-hour for all the energy developed. During 1922 the rental to the government is expected to exceed $200,000. Renewal of the lease, Secretary Weeks said, will enable Southern industries served by the Alabama Power Company through its interconnections to plan against possible recurrence of drought and coal shortage next year.

Mr. Martin on Company's Achievements

Discussing the renewal of the lease, Thomas W. Martin, president of the Alabama Power Company, said:

"Our present lease with the government for the Sheffield steam plant expires Dec. 1, and it had been evident for some time that our company would be unable to supply the demand of power in this state during the coming winter without the assistance of the Sheffield plant. The Mitchell Dam will be completed during the early part of the spring of next year, but even with that plant the company will probably be unable to meet the demands for power during the low-water seasons of next year without the government plant at Sheffield. In addition, the present demand of the power companies in the other Southern states is much in excess of their capacities, and they will require assistance during the coming winter and for a considerable part of next year. We are now and have for some time been supplying power generated at the Sheffield plant to the companies in Georgia and North and South Carolina. This has been of great assistance in their districts in keeping numerous industries and utilities operating."

Several thousand miles of high-voltage transmission lines are now being used by the Alabama Power Company, and with its various interconnections in Alabama, Tennessee, Georgia, North and South Carolina, the system now, according to President Martin, is the largest in the whole country.

Edison Visits Schenectady

Sees General Electric Plant for First Time in Quarter Century and Views New Inventions

FOR the first time in twenty-five years Thomas A. Edison visited the General Electric Comany's plant at Schenectady, N. Y., on Wednesday of this week, his visit making a red-letter day for the great establishment. He was received by the president and other high officers of the company and escorted over the plant, where he saw the newest inventions and developments and met a number of former associates and employees of his own who were connected with the industry in its pioneer days. Among the objects of special interest that Mr. Edison inspected were the new high-powered vacuum tubes, the recently perfected mercury boiler and the machine for registering the voice by photographic means on motion-picture films in order to produce the long-looked-for "talking movies." Dr. Steinmetz gave an exhibition of his artificial lightning-making machine for Mr. Edison's benefit, and in the accompanying illustration he is showing the visiting inventor broken porcelain insulators and a piece of a tree limb which he had shattered a few minutes before in a mimic lightning storm.

Courtesy of General Electric Company

STEINMETZ ENTERTAINING EDISON AT SCHENECTADY PLANT

President Appoints Coal Commission

President Harding has announced the appointment of the Fact-Finding Coal Commission of seven men to study the coal industry and the problems developed by the recent strikes and to make recommendations to Congress which may serve to bring about legislation to prevent recurrent labor troubles in the coal fields. The appointment of the commission was authorized by Congress.

The commission consists of John Hays Hammond, engineer; Thomas Riley Marshall, former Vice-President of the United States; Judge Samuel Alschuler of Chicago, a United States Circuit Judge, who has acted as an arbitrator in recent labor disputes; Clark Howell, editor of the *Atlanta Constitution;* George Otis Smith, director of the United States Geological Survey; Dr. Edward T. Devine of New York, a writer on social and economical questions, and Charles P. Neill of Illinois, former Federal Commissioner of Labor. John Hays Hammond was elected chairman of the commission by his fellow-members at the first meeting, which was held in Washington on Wednesday of this week.

Federal Power Commission Expedites Work

The staff of the Federal Power Commission is engaged in an active endeavor to hurry action on all pending applications. Of the 349 applications which have been filed with it, 201 have been acted on. Sixty-four preliminary permits have been issued, sixty-four licenses have been issued, twenty-five applications have been rejected, and forty-eight applications have been withdrawn or canceled. Of the remaining 148, there are thirty-five applications on which action has been suspended indefinitely because the commission must await the action of some other agency before it will be in a position to consider the case. In this category come the St. Lawrence and Colorado River applications and those on the Columbia River which affect the Columbia basin project in the state of Washington.

Of the remaining 113 applications, thirty are so incomplete that the commission cannot act on them. When the act was passed a flood of applications poured in before rules could be drawn or forms prepared. So as not to work an injustice or to cause unnecessary delay in prospective developments, the commission accepted any informal application or declaration of intention.

When applications now are received, it is the policy of the commission to require the applicant to proceed actively with his undertaking or to throw out the application. The purpose is to save the commission the burden of correspondence, of investigation and of public hearings which can have no immediate result. There is also the matter of preventing "blue-sky" promoting based on the false claim that the applicant enjoys certain rights.

Edison Association Officers

At the concluding session of the convention of the Association of Edison Illuminating Companies at White Sulphur Springs, West Va., last week, Matthew S. Sloan of the Brooklyn Edison Company was re-elected president and John F. Gilchrist of the Commonwealth Edison Company of Chicago was re-elected vice-president. Samuel Ferguson of the Hartford (Conn.) Electric Light Company was elected treasurer, and Preston S. Millar of the Electric Testing Laboratories of New York was re-elected secretary and assistant treasurer.

The executive committee comprises the officers and the following members: Samuel Insull, Commonwealth Edison Company, Chicago; W. W. Freeman, Union Gas & Electric Company, Cincinnati; Charles L. Edgar, Edison Electric Illuminating Company of Boston; J. B. McCall, Philadelphia Electric Company, and John W. Lieb, New York Edison Company.

A most interesting symposium of European impressions was given on the evening of Oct. 11, at which time John W. Lieb spoke of the opportunities which are available for hydro-electric development in Italy, where market conditions and stability of enterprise warrant generous encouragement from American investors. W. H. Patchell, vice-chairman of the Institution of Mechanical Engineers of Great Britain and an eminent consulting engineer, reviewed briefly advanced steam and electric practice followed in recent British and French installations, and K. Yamaguchi of Tokio spoke of the marvelous growth of hydro-electric development in Japan.

As a part of the report of the lamp committee an exhibit was given of a heterogeneous group of incandescent lamps purchased in various sections of the country from contractor-dealers, drug stores, hardware stores and other places. This exhibit indicated to what extent the average user is imposed upon by the seller of inferior lamps and in contrast showed the marked uniformity and superiority of the "Mazda" lamps.

Civil Engineers Discuss Water Power

San Francisco Meeting Given Over Largely to This Subject—Problems and Developments in West Create Lively Interest—Hetch Hetchy Project Inspected

THE fall meeting of the American Society of Civil Engineers, held in San Francisco from Oct. 4 to Oct. 8, was given over almost entirely to a discussion of water-power development, a problem in which the West is so vitally interested. The marked interest in the discussion of this subject was evidenced by the large attendance and close interest at all sessions. Each morning session was attended by about 350.

After the opening address of President John R. Freeman, noted in last week's issue, an illustrated talk on the Colorado River development was given by A. P. Davis, director of the United States Reclamation Service, who said that the river can be made to develop 6,000,000 hp. and to irrigate 6,000,000 acres. Its complete and efficient use for power requires large storage, though the most urgent need is the control of the destructive floods poured over the lower valleys every year. J. B. Lippincott of Los Angeles, in discussing Mr. Davis' paper, said that if federal development of storage and power could not be begun soon, the federal authorities should at least allow private enterprises, which stood ready, to undertake it.

O. C. Merrill, the executive secretary of the Federal Power Commission, said that in the two years since the water-power act was passed 348 applications for permits, aggregating more than 20,000,000 hp., have been filed with the commission. Fifteen licensed developments, involving an estimated installation of 1,880,000 hp. and an investment of $220,000,000, are either completed or under construction, or one and a half times as much as was constructed under federal authorization in the twenty years preceding the passage of the act.

PACIFIC COAST DEVELOPMENT

F. H. Fowler, district engineer United States Forest Service, San Francisco, in a paper on "Water-Power Potentialities of the Pacific Coast," showed that practically all the Western coast is within a 500-mile radius of the two great sources of power on the Colorado and Columbia Rivers. The enormous power possibilities here, however, cannot be developed economically except in large blocks, and consequently markets for the power must be found before development will be feasible. In the long run oil cannot be a competitor of hydro-electric power. The entire Western region, he said, could be supplied from developments on the Colorado and Columbia if this power could be successfully transmitted over distances of 500 miles.

John D. Galloway, consulting engineer, San Francisco, presented a paper on "Hydro-Electric Developments on the Pacific Coast." He discussed the necessity for avoiding a conflict of irrigation and power interests in water storage. Power demand in California, he said, has been increasing three to four times as fast as the population. By 1930, he estimated, the annual energy output will exceed 10,000,000,000 kw.-hr.

M. M. O'Shaughnessy, city engineer of San Francisco, expressed a view favorable to state ownership of power development only when the entire power resources of an extensive area can be tied together and controlled as one system, and when the state shall have the right to condemn all of the present power companies' holdings, as at present all of the good developments have been taken by the power companies and the state would have to content itself with projects of second class. Such developments, he said, must be on a sound basis, very unlike the impracticable scheme of the California water and power act now proposed.

HIGH-VOLTAGE TRANSMISSION

F. W. Peek, Jr., consulting engineer, General Electric Company, Pittsfield, Mass., in his paper on "High-Voltage Power Transmission," showed that the ultimate voltage of transmission lines would not be limited by engineering difficulties, but rather by sources and markets for power. In his opinion it will be necessary to have a minimum of 100,000 kw. of power per circuit to be transmitted before 1,000,000-volt transmission will be economically feasible, in view of the great cost of lines at very high voltages. A 1,000,000-volt transmission line, for example, should have tubular conductors 6 in. in diameter, spaced 30 ft. apart on 20-ft. insulators, or towers probably about 200 ft. high. Prof. Harris J. Ryan, Stanford University, who presented a paper on "High-Voltage Phenomena Encountered in Power Transmission," agreed with Mr. Peek that 100,000 kw. per circuit is the minimum power that can be economically transmitted at 1,000,000 volts.

H. W. Dennis, consulting engineer of Southern California Edison Company, co-author with H. A. Barre, executive engineer of the same company, of a paper on electric power in southern California, said that in the territory served by the Southern California Edison Company the population had increased over 300 per cent between 1910 and 1920 and that during that time the company had increased its output from 379,900,000 kw.-hr. to 1,079,000,000 kw.-hr. During the next six years 322,000 hp. will be developed and a distribution system provided at a total cost of about $125,000,000. In 1922 the company is expending $27,000,000 for new water-power plants and additional distribution facilities.

The conclusion arrived at in the paper presented by C. F. Loweth, chief engineer Chicago, Milwaukee & St. Paul Railway, on "Hydro-Electric Power Development as Related to Electrification of Railroads," was that it is reasonably safe to assume that hydro-electric power will be a large factor in steam-railway electrification under the following conditions: (1) When it is available over such an extended area as will include a large main track mileage for the individual railroad under construction, (2) when the several sources are tied in together so as to insure reliability, (3) when it can be contracted for extending over long periods, and (4) when its cost reduced to terms of locomotive tractive effort is cheaper than that of steam-generated power."

Following the Thursday evening meeting, the delegates went by train to inspect the Hetch Hetchy combined municipal water supply and hydro-electric project of the city of San Francisco. Here an opportunity was afforded to study in detail a typical Western development of large proportions. In its present stage work is under way on a concrete and an earthen dam, an 18-mile tunnel, forebay, penstock, power house and other construction work incidental to a combined water and power development served by its own 68-mile railroad.

Weymouth Plant to Afford Interconnection Facilities

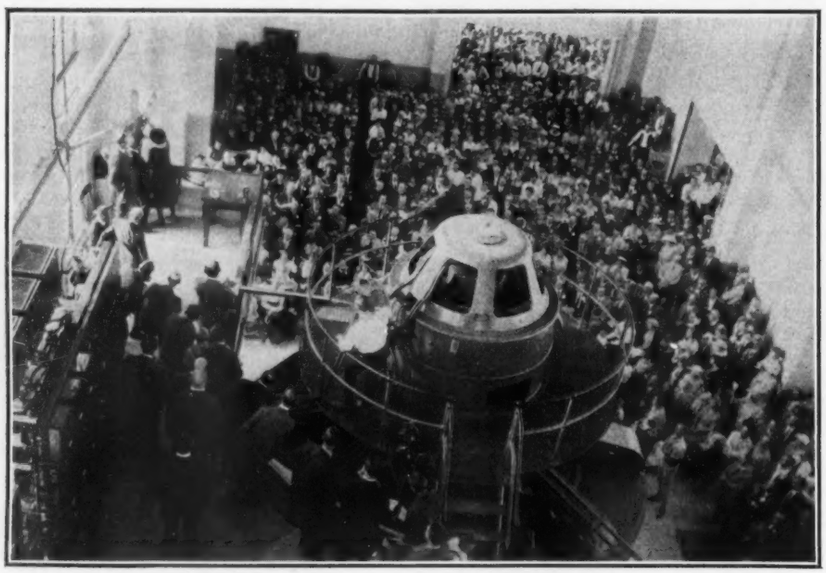
The new generating plant about to be built at Weymouth, Mass., by the Edison Electric Illuminating Company of Boston, as announced in the *Electrical World* for Oct. 7, page 788, had its origin in the fact that the 30,000-kw. unit now being installed by the company at its L Street station in South Boston will make further expansion at that site impossible without radical changes. The Weymouth plant will be about 2 miles from the harbor at tidewater, and coal barges can reach it by ship canal.

The company is at present supplying Weymouth and the adjacent city of Quincy with electrical energy, and the main cables which pass by the new site will conveniently serve as an initial tie line between the new plant and the L Street station, 8 miles distant. It will also be easy to take energy from this plant for any electrification scheme of the steam railways or to tie into the proposed superpower line along the Atlantic Coast.

The property when filled to the bulkhead lines established by the government will consist of about 60 acres. The plans will be prepared for a station that will ultimately have a capacity of approximately 300,000 kw., together with the necessary outdoor switching, transformer stations and administration buildings and storage capacity for at least 300,000 tons of coal. Tentative preliminary plans have been based upon an initial installation of two 30,000-kw., 60-cycle turbines with boiler plant sufficient for one unit.

Putting Pit River No. 1 Into Service

The formal opening of Pit River No. 1 power plant of the Pacific Gas & Electric Company, in northern California, on Sept. 30, brought together 200 bankers, business men and engineers, invited guests of the power company, who journeyed from San Francisco on a special train, and representatives of many northern California communities. The ceremonies at the plant as well as at the Vaca substation, 28 miles from Sacramento, the terminus of the 200-mile, 220,000-volt transmission line from the Pit River plant, were under the direction of the civic organizations of northern California. To the accompaniment of rousing cheers, a switch was closed at the Pit River plant at 4:30 p.m. by Miss Isabel Creed, daughter of President W. E. Creed of the Pacific Gas & Electric Company, and at the same moment an answering cheer arose from the Vaca substation, where flashing of lights, increasing in brilliancy as the current reached its maximum, and an American flag slowly rising as a motor to which the ropes of the banner were attached began to operate, told several thousand waiting persons that the great undertaking had been achieved.



GREAT CROWD CHEERS OPENING OF PIT RIVER PLANT NO. 1

Middle West Utilities Gets Syndicate Holdings

The Middle West Utilities Company announces that it has acquired the entire holdings of the syndicate formed late in 1921 which obtained a controlling interest in the Ironwood & Bessemer Railway & Light Company, the Ashland Light, Power & Street Railway Company and the Big Falls Water Power Company. After the acquiring of control in the three companies, the name of the Big Falls Water Power Company was changed to Lake Superior District Power Company, and under that name they were merged a few months ago. By the transaction just consummated the Middle West Utilities Company, which was a participant in the syndicate, obtains for itself all of the common stock of the Lake Superior District Power Company together with certain preferred holdings.

The Lake Superior District Power Company serves Ashland, Hurley and Ladysmith, Wis., and Ironwood, Bessemer and Wakefield, Mich., together with fifteen other communities and a large number of iron mines in the Gogebic iron range in Wisconsin and Michigan. The company is now constructing a large hydro-electric plant on the Flambeau River at Big Falls, Wis. The possibilities for the development of electric power business in the territory served are very great.

New Ohio Plant to Operate at 530 Lb. Pressure

The Ohio Power Company, a subsidiary of the American Gas & Electric Company, is preparing plans for a new power station to be erected on the Muskingum River at Philo, Ohio, about 9 miles south of Zanesville, and contract has been placed for two 35,000-kw. General Electric turbines, which will be operated at 530 lb. steam pressure and a total temperature of 725 deg. F. at the turbine throttle. A contract has also been placed with the Babcock & Wilcox Company for the boilers, which will be built for 650 lb. working pressure, although they will be operated at 550 lb. pressure. The boiler units will consist of boilers, superheaters and economizers of the same design as those being installed for the Waukegan Generating Company. It is understood that many new features will be embodied in the design of this station. Sargent & Lundy, Chicago, are the consulting engineers.

National Radio Chamber to Investigate Broadcasting

It is officially announced that the newly organized National Radio Chamber of Commerce, with headquarters at New York, has virtually completed the selection of its executive personnel and will at once through a committee of investigation turn its attention to the broadcasting problem. William H. Davis, New York, is the president of the chamber, and its declared purposes are these:

"To aid the government and the American people in peace or war, to eliminate the confusion of rapid development, to work with the federal departments in devising a rational scheme of broadcasting for the nation, to promote on a universal scale effective organization of all radio instrumentalities, and in general to undertake at once the solution of the pressing problems of the industry now leading to conflict."

Power Club Will Discuss Temperature Ratings

At the fall meeting of the Electric Power Club, to be held from Oct. 30 to Nov. 2 at Grove Park Inn, Asheville, N. C., an important feature will be the report of the temperature rating committee of the Motor and Generator Section, which will concern a proposal to substitute as a standard of the club a 40-deg. single rating for the present 40-degree double rating and 50-degree single rating. The sentiment for the 40-degree single rating is said to be growing, but no final vote can be taken at this meeting, because to change or rescind a standard requires three months' notice. An agreement to take a letter ballot on the matter or even to settle it at the next meeting may possibly be reached.

Other features of the program will be as follows:

MONDAY, OCT. 30

Morning.—Section and committee meetings.
Afternoon.—Meeting of the board of governors.
Evening.—President's address, R. J. Russell; reports of officers; "Advantages and Limitations of Different Advertising Mediums," C. H. Clark, advertising manager Robbins & Myers Company; report on activities of Electrical Manufacturers' Council, S. L. Nicholson.

TUESDAY, OCT. 31

Morning.—Section and committee meetings.
Afternoon.—Sports.
Evening.—Committee reports; "Neglected Possibilities of Publicity for Member Companies," H. W. Young; "Extent of Foreign Competition at Home," S. L. Nicholson.

WEDNESDAY, NOV. 1

Morning.—Section meetings.
Afternoon.—Meeting of the board of governors.
Evening.—Dinner: "First-Hand Observations of Conditions in Europe Today," James Burke; "Opportunities for Electrical Apparatus Manufacturers in the Orient," S. Glen Vinson.

THURSDAY, NOV. 2

Morning.—Committee reports; "Cancellation of Orders and Business Morality," Alfred E. Waller; "Repair and Replacement Policies and Proper Marking of Nameplates," B. Lester.

Contractor-Dealer Body Changes Name

It Will Hereafter Be the "International Association of Electragists"—Parallel Sections Are Set Up to Solve Difficulties That Arise in Connection with the Labor Problem

CHANGES in the constitution making its new name "The International Association of Electragists," separating individual memberships from state association, affiliation, limiting to its own members only the right to use the new copyrighted term for contractor-dealers ("electragists"), and setting up separate sections for union and open-shop employers, were among the steps taken by the former National Association of Electrical Contractors and Dealers at its Cincinnati convention Oct. 11 to 14.

National Chairman James R. Strong in his official address on Wednesday spoke of the problems of the association in helping both large and small contractor-dealers, as well—those employing union labor as those employing non-union labor, and made a plea for good-fellowship in approaching all association problems.

George M. Verity, president of the American Rolling Mills Company, Middletown, Ohio, read a paper on "Business Today and Tomorrow," outlining the sweeping changes which have taken place in business and industrial relations. "Yesterday," he said, "the great problem was production. The problem of the future is efficiency in distribution in every line of human endeavor."

W. R. Herstein, Electrical Supply Company, Memphis, Tenn., spoke on the relations between the electrical supply jobber and the "electragist," indicating how the wholesaler can be of service to the electrical contractor-dealer through the following out of business policies of constructive value to each. Frank E. Watts of the *Electrical Record* followed with a talk on the aims of the Joint Committee for Business Development.

MERCHANDISING LESSONS IN A PLAY

"The Awakening of Mr. Moss" was the title of a four-act comedy presented by employees of the Union Gas & Electric Company, under the direction of T. L. Phillips. It recounted the business transformation of a discouraged electrical contractor—with the aid of a local central-station wiring campaign—into a hustling "electragist" with an attractive store, an electrically equipped home of his own and a keen eye for business.

On Thursday Arthur L. Abbott of St. Paul discussed the new "Manual for Estimating" prepared by the committee of which he is chairman. F. M. Feiker, vice-president McGraw-Hill Company, New York, sent a message to the convention emphasizing the point that national associations and national movements will be effective only as they stimulate individual action in getting after business. Edward T. Miller, Chicago, explained how the United Typothetæ of employing printers functions with its parallel union and open-shop sections. E. H. Eardley, Salt Lake City, in his report as chairman of the engineers' committee, dwelt upon the need for more specific specifications for electrical work.

EIGHT GEOGRAPHICAL DIVISIONS

Friday morning's session took up the ratification of changes in the constitution as recommended by the association's executive committee. By vote of the convention, the name of the association was changed to "The International Association of Electragists" in recognition, first, of the membership on both sides of the boundary between the United States and Canada and, second, to give wider currency to the coined word "electragist." It is planned to hold meetings or "regional" conventions of members in various sections of the country. For organization purposes the membership is divided into eight geographical divisions, each of which elects a member of the executive committee. A "closed-shop" section and an "open-shop" section of the association were also authorized and were later formed by their respective adherents, L. K. Comstock, New York, being elected to head the section of union employers and Arthur L. Abbott the open-shop advocates.

Lawrence W. Davis, special representative of the association, told how membership in the association benefits the individual electrical man.

"The National Electrical Code—Its Past, Present and Future" was discussed by Dana Pierce, chairman of the electrical committee of the National Fire Protection Association and vice-president of the Underwriters' Laboratories. A. Penn Denton, the association's representative on the code committee, told of the trend of the committee's opinion toward abolishment of the "660-watt rule" and placing dependence on limiting the number of outlets on a circuit to be supplied through a branch fuse. Approval of the 15-amp. fusing of circuits where the No. 14 circuit wire is carried directly into the outlet or socket wired to is also under consideration.

CINCINNATI'S SALES CAMPAIGN

W. W. Freeman, president of the Union Gas & Electric Company, told how 20,000 houses are now being wired each year in Cincinnati because of an aggressive sales campaign. Of the total number, 53 per cent are handled on the company's own books, while the remaining 47 per cent have been taken and handled by non-affiliated contractors.

John F. Gilchrist, vice-president Commonwealth Edison Company, Chicago, referred to the close relationship existing between all groups in the industry and declared that lack of prosperity in any branch tends to drag the whole industry down. Assuming that an installation can be sold to the average customer costing as much as the $200 investment per kilowatt behind the central station's service line, Mr. Gilchrist pointed out that the $300,000,000 needed in the near future to finance central-station extensions will be duplicated in the sales of equipment and merchandise passing through electrical trade channels.

William L. Goodwin of the Society for Electrical Development described briefly the work of that organization and was followed by Miss Alice Carroll of the society's staff, who gave a talk on "How to Sell the Electrical Idea to the Ladies."

The 1923 convention of the International Association of Electragists will be held at Washington, D. C., probably about the middle of September.

Permits for the Deschutes

Federal Commission Issues Them to Two Oregon Companies—Colorado River Permit Extended

THE Federal Power Commission at a meeting on Oct. 10 authorized the issuance of a preliminary permit to the Pacific Power & Light Company of Portland, Ore., covering a project on the Deschutes River at the reclamation site, 20 miles above the mouth of the river. H. S. McGowan of McGowan, Wash., was also an applicant for this permit.

The commission authorized the issuance of a preliminary permit to the Columbia Valley Power Company covering two sites on the Deschutes River. The company applied for a permit to cover five sites on a 34-mile stretch of the river just below the junction with the Metolius River. It was held, however, that the company should demonstrate what it could do with the two upper sites before the permit was extended to include the other three. A conflicting application by H. S. McGowan was rejected.

The preliminary permit of James B. Girand covering a development on the Colorado River was again extended until March 19, 1923. The extensions have been necessary because of objection on the part of the Reclamation Service.

The application of the late William Park Mills covering a project on the Vermilion River in the Cabinet National Forest was rejected. Preliminary permits to E. Fletcher of San Diego were authorized covering a 3,600-hp. development on Santa Isabel Creek in the Cleveland National Forest and a 900-hp. development on Boulder Creek in the same forest.

The commission has received an application from Frank I. Reed of Anchorage, Alaska, for a preliminary permit covering the construction of a dam and a power house in connection with a project on Eklutna River and Lake in the Knik region of Alaska.

Dr. Kennelly's Impressions

Favors the Interchange of Graduate Students in Science Between America and France

THAT both the United States and France would benefit by an interchange of graduate students in engineering and the sciences is one of the conclusions of Dr. A. E. Kennelly of Harvard University, who recently returned to this country after a year's absence in France, where he represented seven American universities as exchange professor in applied science. Dr. Kennelly was the first exchange professor to go to France to give instruction in applied science or engineering. He exchanged with Prof. Jacques Cavalier, rector of the University of Toulouse, and during his visit gave eighty-four lectures in French upon power transmission, telephony, radio and the skin effect, besides publishing a book on hyperbolic functions for his overseas students. These lectures were delivered at Grenoble, Lyons, Marseilles, Toulouse, Bordeaux, Nancy, Lille and Paris, including the École Supérieure d'Électricité of the last-named city.

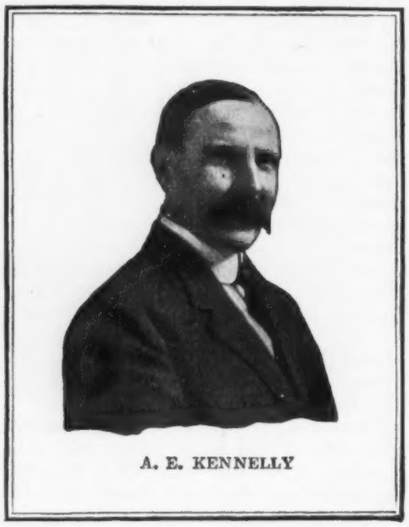
Dr. Kennelly received the honorary degree of doctor from the University of Toulouse, this being the first honorary degree in science granted by that institution since its founding in 1229. He also received an honorary membership in the Société Française des Électriciens and was made a Chevalier of the Legion of Honor.

FRENCH THOROUGHNESS PRAISED

"Thoroughness is the keynote of French higher education in science and almost all else," said Dr. Kennelly to a representative of the *Electrical World*. "The average man in France is better prepared in fundamentals, whereas in America students are more experienced in what might be called the craftsmanship side of technical training. The foregoing is also the case in French secondary schools. Athletic life and student co-operation are less developed than here. In mathematics, physics and chemistry French students, on the average, are distinctly ahead of those in this country, the latter excelling in laboratory and shop activities. All French education from early ages upward is focused on the 'concours,' or competitive examinations. Instead of so-called 'passing marks' being established, a stated number of students receiving the highest marks are accepted for admission or promotion, the remainder being obliged to drop out, repeat or seek other lines of activity. This gives a selected body of students, who work like intellectual beavers from the beginning to the end of their courses. The graduate in science is a highly trained specialist, but has had little contact with industry and practice. This comes later."

At the age of twenty-three or twenty-four, when the average man completes his scientific courses, the necessity for eighteen months' military service confronts him. Dr. Kennelly said that the French nation is at one in its conviction of the absolute necessity of continual preparedness for defense against possible future German aggression; that the warmest friendship for the United States is country-wide, and that French opinion is universally to the effect that charges of militarism brought against France in certain quarters are unjust in the extreme. In the devastated areas the appreciation of Mr. Hoover's remarkable relief work during the war is still intense.

Financial conditions in France are in a perilous state, Dr. Kennelly said, but the economic salvation of the country, as always, lies with the peasant. The cost of living is about four and one-half times the pre-war cost, while the compensation of teachers has roughly



A. E. KENNELLY

doubled. Under present conditions there appears no possibility of modifying French educational methods to parallel closely those of this country, or vice versa. The interchange of graduate students, however, for say one year's resident study, would be the means of a closer understanding between the French and American universities and would give the educational world on each side of the Atlantic great benefits, besides broadening the training of individuals participating in such a transfer.

New England N. E. L. A. Section Chairmen Named

These chairmen of the major sections of the New England Geographic Division of the National Electric Light Association have been appointed for 1922-23 by President E. A. Barrows: Commercial, H. W. Derry, Hartford Electric Light Company; Technical, Samuel B. Swan, Narragansett Electric Lighting Company, Providence; Accounting, I. S. Hall, Charles N. Tenney & Company, Boston; Public Relations, E. L. Milliken, Blackstone Valley Gas & Electric Company, Woonsocket, R. I.

Federal Engineer Sees West

Finds the Public in Earnest About Full Use of Water Power and Expects Markets to Grow in Size

AFTER a visit to a number of the power-producing streams of the West, Col. William Kelly, the chief engineer of the Federal Power Commission, has returned to Washington more thoroughly impressed than ever with the opportunities in that section offered industries in which power is a relatively large factor. While he realizes that the distance of these power sources from some markets offers an obstacle which cannot be overcome in many cases and does not expect to see any marked exodus of Eastern industries to the West, he does believe that there will be an increasing transition as the cost of power increases in the East and as the demand grows more insistent that the public utilities shall have the first call on hydro-electric power in the more congested regions. That the people in the West favor the utilization of the maximum amount of its water power is indicated, Colonel Kelly points out, by the very general response when the Southern California Edison undertook the financing of its great development program. He saw many other indications that the public is determined to utillze this resource which has lain dormant so long.

MANY PROJECTS UNDER WAY

Colonel Kelly visited the work being done by the Southern California Edison Company along Big Creek and on the Upper San Joaquin. He visited the two plants now in operation on the Feather River and Pit River plant No. 1 of the Pacific Gas & Electric Company, as well as the Clackamas River project of the Portland Railway & Light Company. His trip also included visits to the Northwestern Power Company's site on the Lewis River and the Priest Rapids site and Kettle Falls on the Columbia River. On his return to the East he stopped at Flathead Lake and visited also the site of the development proposed by the city of St. Paul on the St. Croix River. In Illinois he went down the Desplaines River and looked over the work being done on the Illinois waterway.

In some areas of the West, Colonel Kelly believes, hydro-electric development is progressing more rapidly than is justified by the probable amount of power that the region can absorb. An important factor in stimulating water-power development was the high price and scarcity of fuel oil at the time the water-power act was passed. Since that time the fuel-oil situation has become fairly satisfactory, and many of the plants which expected to be forced to resort to other power have been able to continue the use of their oil-burning equipment. Colonel Kelly finds, however, that there is general uneasiness on the part of the users of fuel oil, partly because of prices and partly because of early probable limitations of supply.

A. E. S. C. Is Now Handling 106 Projects

The growing interest in standardization on the part of almost every American industry is emphasized by the quarterly report of the activities of the American Engineering Standards Committee issued from the headquarters of the committee at 29 West Thirty-ninth Street, New York City.

Of the projects which have official status before the committee, twenty are concerned with mechanical engineering, seventeen are civil-engineering projects, fifteen are electrical, three are automotive, ten are concerned with transportation, ten with ferrous metals, eleven with chemistry, five with non-ferrous metals, four with mining, two with textiles, one with shipbuilding, and eight projects are of general interest.

Twenty-four standards or safety codes have been approved and thirty-six are up for approval. The remaining forty-six projects represent codes and standards which are either in the process of formulation or which are now being considered by committees of representatives designated by the various bodies, industrial, technical and governmental, interested in each particular subject. In this way more than two hundred such bodies are officially participating in the work of the committees through their accredited representatives.

A regular interchange of information as to the status of work under way is maintained by the American Engineering Standards Committee with the national standardizing bodies of Austria, Belgium, Canada, Czechoslovakia, France, Germany, Great Britain, Holland, Italy, Japan, Norway, Sweden and Switzerland. This information is issued in the form of quarterly reports and includes a statement of the status of each project on which work is actively under way.

Reciprocal Registration Rules Prepared by Council

Rules for reciprocal registration of professional engineers were drawn up by the Council of State Boards of Engineering Examiners, representing sixteen states, at their Chicago conference on Oct. 2 and 3. The rules provide that an engineer registered in one state may be permitted to practice in other states which have accepted this reciprocal registration. These articles of agreement will be sent to the various state boards of engineering examiners for final ratification.

The council also passed a resolution urging the necessary change in state laws so that an engineer registered in one state may be granted reciprocal registration in another state without being required to pay a second registration fee. An investigating committee was appointed to consider reciprocal registration with Canada and Mexico.

Chicago was chosen for the council's 1923 October meeting place. The new officers elected were: President, John T. Cox, Ann Arbor, Mich.; vice-president, O. Lauxgaard, Portland, Ore.; secretary, P. H. Daggett, Chapel Hill, N. C.

California Rate Reduction

People Will Save $6,000,000 a Year on Electric Rates, According to Commission's Estimate

AN ANNUAL saving to the people of California of $20,350,000 in rates and fares has been figured out by the California Railroad Commission as the result of reductions in public utility charges. Of this amount $6,000,000 is estimated as the saving in electric rates, $10,450,000 being credited to lower railroad rates and the rest to reduced gas rates and express charges.

"This saving to consumers," said Harley W. Brundige, president of the commission, "has been effected notwithstanding the fact that utility rates have been maintained at all times at levels distinctly below the 'cost of living' figures compiled by the federal government and the commodity price indices of Dun and Bradstreet. While living costs are given today by the United States Bureau of Labor Statistics as 66⅔ per cent above the 1913 base, electric prices are only 16 to 20 per cent above pre-war levels. In the peak of 1920 living costs went to 219 from a base of 97 in 1913. In the same period the average increase in electric rates did not exceed 130 to 143 from a base of 100. In other words, cost of living went up 122 per cent and is still up 66⅔ per cent, while electric increases ranged from 30 to 43 per cent at the peak and present rates are only 16 to 20 per cent above the normal base of 100.

COMMISSION CLAIMS THE CREDIT

"To me," Mr. Brundige continued, "this showing is very significant as completely justifying regulation. The figures show that during the peak of prices the utilities were not permitted to profiteer and at the same time they received reasonable increases so that they could function properly. As was said at the public utilities session of the recent meeting of the American Bar Association, 'A starved horse cannot pull a full load.' The utilities were enabled to pull a full load. It was recognized that a period of advancing prices put a severe strain upon regulation, but it met the test. It is equally obvious that regulation would fail if it were not vigilant to take advantage, promptly and boldly, of every opportunity to keep utility prices in line, even a little ahead, of a declining commodity market."

The reduction in electric rates from peak prices, as allocated to the principal companies, indicates a sectional distribution as follows: Pacific Gas & Electric Company, $2,000,000; Great Western Power Company, $500,000; Southern California Edison Company, $3,000,000; San Joaquin Light & Power Corporation, $500,000.

Brief News Notes

Detroit Edison Has New Plant Ready.—Fires have been started under the boilers of the new Bunch Creek steam plant of the Detroit Edison Company in Marysville, Mich., which will furnish power for Port Huron and other St. Clair River towns. The plant cost $2,500,000.

Maximum Rate Cut at Springfield, Mass.—The United Electric Light Company, Springfield, Mass., has announced a reduction of price from 10 to 9 cents per kilowatt-hour as the maximum rate for residential lighting, effective Nov. 1. The 10-cent rate has been in force since 1918. No other reduction of rates is to be made by the company at present.

Texas University Establishes Course in Public Utility Economics.—A course in public utility economics, covering lectures on light and power companies, street and interurban railways, franchises, accounting and eight other topics, is being given at the Southern Methodist University at Dallas, Tex., under the auspices of the Texas Public Service Information Bureau.

Fifteen California Towns Ask Lower Rates.—The California Railroad Commission has recently heard evidence on the plea made by fifteen municipalities for a further reduction in the electric lighting rates of the Southern California Edison Company. The cities concerned are Alhambra, Anaheim, Arcadia, Chino, Colton, El Monte, La Verne, Lindsay, Long Beach, Monrovia, Newport Beach, Pasadena, Porterville, Ventura and South Pasadena. Decision is not expected for some time.

Supreme Court's Views on Valuation.—A brief prepared by Victor E. Wilson of Lincoln, Neb., and recently filed with the Nebraska State Railway Commission in connection with valuation proceedings of the Omaha & Council Bluffs Street Railway Company, has been issued in available form. The significant feature of the brief is a review of United States Supreme Court decisions as to what are relevant facts to prove value. Mr. Wilson's conclusion is that facts as to the cost of reproduction now constitute the only evidence considered by the court when they are present in the record.

California Chambers of Commerce Oppose Water and Power Act.—Upon the leadership of the California Development Association, the only statewide civic body in California, resolutions against the proposed water and power act have been passed by the chambers of commerce in Berkeley, Lassen County, Pittsburg, Red Bluff, Sebastopol, San Francisco, San Jose, Redwood City, San Benito County, Santa Rosa, Livingston and Vallejo. The Los Angeles chamber also is on

record against the measure. All these bodies are carrying on a fight in their respective communities to aid in its defeat.

Noblesville Company Seeks to Dam White River.—The Noblesville (Ind.) Heat, Light & Power Company is meeting with opposition in its plan to build a dam across White River 4 miles north of the city. Difficulties with the Indianapolis Water Company, which feared interference with its supply of water, had just been compromised and a contract between the two companies approved by the Indiana Public Service Commission when an injunction was asked by a private landowner who fears the backwater from the dam will injure his property. This action was filed in the circuit court last week.

Lakeside's New Unit Placed in Service. — Another unit was placed in service at the Lakeside plant of the Milwaukee Electric Railway & Light Company on Oct. 6, when the company began the operation of its new 30,000-kw. turbo-generator. The new unit represents an investment of $1,500,000 and brings the rating of the station up to 70,000 kw., two units rated at 20,000 kw. each having been installed last year. The ultimate rating of the plant, which is said to be the only large station in the world using only pulverized fuel for steam generation, is 200,000 kw. The work of designing the turbine began last winter and the field work started this spring.

Illinois Utilities Building New Transmission Lines.—The Public Service Company of Northern Illinois, which affords continuous service to an area of 5,800 square miles, is beginning construction on three new transmission lines. A 33,000-volt line will start at Wilmington, where it will be connected to the transmission line from the Joliet station and then extended to Kankakee. Another line is to extend from Blue Island to Chicago Heights, making the fourth to be placed in service between these two points. The third line will be built between Evanston and Lake Bluff on the right-of-way of the Chicago & Northwestern Railroad. All of these lines will, it is expected, be completed before the annual peak-load period.

Sweden's Water Powers.—A European correspondent of the *Electrical World* writes concerning the gigantic project formed in Sweden under governmental auspices to provide electric power for that country and Denmark: "The construction of the power stations, canals and bridges is well under way. In addition to the waterfalls a great number of large rapids are being diverted into the canals, where an immense amount of power will be stored. The hydro-electric stations now under construction will largely exceed in generating capacity the three that the Swedish government now controls, viz., the Trollhättanworks in the south, the Aelvkarle works and the Porjus works in the far north, the combined output of these three stations being about 300,000 hp. A notable piece of engineering is the construction of the regulating dam in Lapland, about 10 miles north of Porjus, which has for its purpose to increase the pressure of the St. Lule-Aely at deep-water level from 30 cu.in. to 160 cu.in. a second. This means an increase of power of no less than 700,000 hp. An immense source of power, about 425,000 hp., is situated in the Götaälv, whence the current will be conducted by way of the Skagarrak to Cape Skagen and from there to Jutland and the island of Zeeland. It has not yet been decided how the current is to be conducted across the sea, but it is likely that this will be done by means of sea cables."

Lightning Fails to Put High-Tension Line Out of Commission.—The accompanying photograph comes from Windsor, Col., where it was taken on

Aug. 17 last during an intensely vivid thunderstorm. Lightning struck within quarter of a mile of the 44,000-volt transmission line of the Western Light & Power Company, shown in the picture, but there was no interruption of service.

Interstate Line Nearly Finished.—Work on the new 110-mile, 60,000-volt transmission line from the Prospect plant of the California-Oregon Power Company to Springfield, Ore., is fast nearing completion, and after Nov. 1 it will be possible to transmit energy from the California plants of the company, several hundred miles away, to the Mountain States Power Company. When the increase in business justifies it the company plans to increase the line voltage to 110,000.

New Company to Take Over Chinese Radio Contract.—A new company is about to be formed under the name of the Federal Telegraph Company of Delaware to take over the thirteen-million-dollar contract with the Chinese government recently secured by the Federal Telegraph Company of California. Owen Young, president of the General Electric Company, will be chairman of the board of the new company, and R. P. Schwerin, president of the Federal Telegraph Company of California, will be its president. The company will be capitalized for $9,500,000, divided into $3,500,000 preferred stock and $6,000,000 common stock. The Radio Corporation of America will buy all of the new preferred stock, and of the common stock the Federal Telegraph Company of California will own 40 per cent and the Radio Corporation of America 60 per cent. The contract calls for the construction of four wireless stations in China, the one in Shanghai to be of great size. The completion of this station will bring direct communication between the United States and China.

Associations and Societies

New York Electrical Credit Association.—A "get-together" meeting of this association will be held at the Hotel Pennsylvania, New York, on Tuesday, Oct. 24, at noon. Carl Schneider of the Federal Reserve Bank of New York will speak on the financial situation and business future.

Commercial National Section, N. E. L. A.—Group meetings of this section will be held next month as follows at the Hotel Somerset, Boston: Nov. 15, 10 a.m., Lighting Sales Bureau, Power Sales Bureau; 2 p.m., committee on electrically equipped furniture, committee on "Electrical Salesman's Handbook." Nov. 16, 10 a.m., Electrical Vehicle Bureau, Merchandise Sales Bureau; 2 p.m., committee on education, committee on commercial service and relations with customers. On Nov. 17 the executive committee of the section will meet at 10 a.m. at the same place. Technical National Section committee meetings will be held in Kansas City, Mo., on Nov. 20-23.

Coming Meetings of Electrical and Other Technical Societies

A complete directory of electrical associations is published in the *Electrical World* in the first issue of each volume. See July 1 issue for latest list.

Electric Power Club—Asheville, N. C., Oct. 30-Nov. 2. S. N. Clarkson, Kirby Bldg., Cleveland, Ohio.

Arkansas Utilities Association—Hot Springs, Ark., Nov. 7-9. R. P. Brown, Little Rock Ry. & Electric Co., Little Rock.

Electrical Credit Association (interstate convention)—Philadelphia, Nov. 10. J. W. Crum, 1328 Land Title Bldg., Philadelphia.

Ontario Association of Electrical Contractors and Dealers—Toronto, Nov. 13-14. J. A. McKay, 24 Adelaide St. W., Toronto.

National Association of Railway and Utilities Commissioners—Detroit, Nov. 14-17. J. B. Walker, New York Transit Commission, New York.

Electrical Manufacturers' Club—Hot Springs, Va., Nov. 15-19.

Electrical Credit Association, Central Division—St. Louis, Nov. 16-17. F. P. Vose, 1347 Marquette Bldg., Chicago.

Electrical Supply Jobbers' Association—Cleveland, Nov. 20-24. Franklin Overbagh, 411 S. Clinton St., Chicago.

American Society of Mechanical Engineers—New York, Dec. 4-8.

Commission Rulings

Principles Followed in Appraisal.—In its recent evaluation of the property of the Colorado Power Company, the Colorado Public Utilities Commission based its findings on the normal cost of reproduction now, with consideration as to the periods of construction and reflecting average costs over these periods, so that the cost used was neither the highest nor the lowest, but included these in the average whenever available, so-called war prices receiving consideration only as they entered into averages or influenced the general trend of labor and material cost.

"Firm" Power and "Dump" Power.—Averring that it has jurisdiction over a rate contract for power supplied to a company distributing power in a "home rule" city when the energy is received in a substation outside of the city, the Colorado Public Utilities Commission permanently suspended rate schedules proposed by the Colorado Power Company embodying both new standard schedules for Denver and other cities and special power agreements with the Carbondale Light & Power Company and twelve other public utility, mining and industrial concerns. The effect of the new rates was an increase of aproximately 40 per cent in the regular schedules and of 20 per cent in the special power agreements, and the cancellation of these agreements, putting those benefiting from them under the regular schedules, means increases for some of the customers ranging from 17.5 per cent to 79.6 per cent over the rates heretofore enjoyed, based on 1919 consumption. These cases were before the commission nearly two years, pending the completion of valuation proceedings. One question involved was whether particular customers were being served with surplus "firm" power at discriminatory prices or with so-called "dump" power. The question of surplus or overbuilt plant was also concerned. The commission found that power furnished continuously to large consumers and causing the principal system peaks, which were simultaneous with other peaks, and causing also a wider variation of load than is caused by any other consumers, is "firm" power, although sold at "dump" power rates because of inability to dispose of the entire product of an overbuilt system at regular rates. The property of the company should, therefore, the commission held, be apportioned between the users of "firm"' power and the users of "dump" power for the purpose of fixing "firm" power rates in cases where the company is unable to dispose of the surplus energy at the regular rate. A transmission line used jointly by the two classes of consumers was allocated on the basis of the relative traffic over the line, and a percentage ratio as between the use of "firm" power and the total use of the line was thereby determined. The company was instructed to make an effort to dispose of its surplus "firm" power at the highest obtainable price while awaiting the time when it can obtain customers at regular rates. The commission found insufficient evidence to enable it to pass upon a charge that the rates charged "firm" power customers were discriminatory as between these companies themselves.

Recent Court Decisions

Power to Render Conclusive Decision on Conflicting Evidence Not Power to Act Arbitrarily.—"The mere fact that an administrative body, like the commission, has to decide some contested question of fact upon evidence presented, which decision is conclusive, does not," the Supreme Court of Errors of Connecticut declared in State vs. Darazzo, a case affecting the commission's power to license jitney operators, "make its action a matter of discretion and arbitrary, unless we use these words in a sense that would class the decision of a court upon a contested question of fact as a matter of discretion and arbitrary." (118 At. 81.)*

Owner of Water Lot Entitled to Proportionate Share of Water Despite Inability of Less Well-Situated Owners to Obtain Theirs.—In Henry Cheney Hammer Company vs. Collins and the Utica Gas & Electric Company an effort was made to restrict the company named in the use it had been making of water impounded for power and manufacturing purposes by what is known as the middle dam at Little Falls. The Supreme Court of New York, equity division, vacated an injunction obtained against the company, asking: "The Utica Gas & Electric Company being entitled to five-seventeenths of one-half of the whole flow, subject to the preferred rights aforesaid, and it being in a position by which it can utilize its just proportionate share of the water which flows to and properly pertains to the north shore of the river, is it to be deprived of the right to use its said share of water because certain other owners are unable to obtain their shares?" The company, the court held, was entitled to its proportionate share of flood water as against the contention of owners of other lots that such water is not waste water. Declaring that the full enjoyment of common water privileges can only be obtained through keeping the water at the level of the crest of the dam, the court found a proposed development of the defendant company entirely reasonable and held that neither the plaintiff nor any other user could be in any manner damaged by the drawing by the defendant of its just proportion of water, rather than allowing it to flow over the dam. (196 N. Y. S. 25.)

City Cannot Be Held Responsible for Delay of State Commission Which Hinders Execution of Contract.—The Supreme Court of New York, Appellate Division, has held, in Degnon Contracting Company vs. City of New York, that contractors with the Public Service Commission for the construction of a subway cannot hold the city liable for negligence of the commission's engineer in delaying to furnish plans.

Commission May Compel Utilities to Cease Operations.—The power of the California Railroad Commission to compel utilities to cease operations held by the commission to be illegal has been sustained by a unanimous decision of the California Supreme Court. The decision was rendered in dismissing a writ of review sought by the Motor Transit Company against an order of the commission relating to a local stage service, but the court's interpretation of the powers of the commission is held to apply in the case of all utilities. The motor company had contended that the commission did not have power to order it to discontinue a local operation because it possessed no jurisdiction to grant "injunctive relief." The court held that the commission has power to make whatever order may be necessary in the exercise of its jurisdiction. As to the enforcement of such an order, the court referred to a former decision upholding the commission's right to punish for contempt and pointed out that the commission has in addition the right to apply to the court for permission to exercise injunctive powers.

Insufficient Insulation of 2,300-Volt Wires Constitutes Negligence.—Weaver vs. Bristol Telephone Company and Bristol Gas & Electric Company was a suit for damages because of the death of a telephone lineman who had hold of an insulator on a telephone pole around which the end of a dead wire connected with a house on the opposite side of the street was wrapped. The pole suddenly sagged under the lineman's weight, causing the dead wire to come in contact with a 2,300-volt line of the electric service company, also on the opposite side of the street and over which the dead telephone wire passed. The Supreme Court of Tennessee found that the defective insulation of the power wire had been established and constituted a ground for the damages awarded, the lineman having no duty of inspection; but inasmuch as violation of a city ordinance by the power company was charged and dwelt on in the trial court's instructions to the jury, while no evidence to show that the injury took place within the city's boundaries was introduced, the Supreme Court remanded the case for retrial. (243 S. W. 299.)

*The left-hand numbers refer to the volume and the right-hand numbers to the page of the National Reporter System.

Men of the Industry

Changes in Personnel
Accomplishments, Responsibilities, Honors, Appointments and Activities of Men Engaged in all Branches of the Electrical Industry

Ward Harrison Takes Office as President of I. E. S.

Ward Harrison, who was elected last spring to the presidency of the Illuminating Engineering Society and took office on the first of October, is the head of the illuminating engineering staff of the engineering department of the National Lamp Works. Mr. Harrison has been responsible for much pioneer illuminating engineering work and has

WARD HARRISON

taken a prominent part in the activities of the electrical industry. He was among the first to conceive the possibilities of high-power gas-filled incandescent lamps for street lighting, and very largely through his experimental demonstration work the city of Chicago was able to adopt the series incandescent lamps as the standard for street lighting a few months after the first gas-filled lamps had been produced in a laboratory.

In addition to authorship of papers covering a wide variety of illuminating engineering subjects which have appeared in the technical press, Mr. Harrison is the author of a textbook entitled "Electric Lighting." For some years he has been a lecturer in the illuminating engineering course at the Case School of Applied Science. He has also been active in the work of the Lighting Sales Bureau of the National Electric Light Association. He became a member of the Illuminating Engineering Society in 1910 and was a vice-president of the society during 1913 and 1914, representing the Pittsburgh Section. Mr. Harrison was born in East Orange, N. J., and was graduated with honors from the Stevens Institute of Technology in 1909. He entered the engineering department of the National Lamp Works of the General Electric Company in the same year and was appointed illuminating engineer of that company in 1914.

Lewis A. McArthur Vice-President of Pacific Power & Light

Lewis A. McArthur, general manager of the Pacific Power & Light Company, Portland, Ore., has just been made vice-president of the company. Mr. McArthur has been with the Pacific company since its organization in March, 1910, when he was made chief clerk to the president. Later he filled successively the positions of assistant to general manager and assistant general manager, and in 1917 he was made general manager. Mr. McArthur is a native Oregonian and a graduate of the University of California.

Henry J. Pierce, president of the Washington Irrigation & Development Company, Seattle, Wash., has just returned from a trip to Europe. Mr. Pierce will remain in New York for about ten days before going West.

Edwin H. Armstrong, inventor of the regenerative and super-regenerative radio circuits, has sailed on the Mauretania for a sojourn of several months in England and France.

Raymond Bennett, formerly general manager of the Douglas (Wyo.) Light Company, and more recently connected with the Sheridan County (Wyo.) Electric Company, has been appointed power apparatus specialist of the Western Electric Company in the Rocky Mountain district. Mr. Bennett is now on a tour of the Eastern plants and branches of the company.

Dr. Charles Russ Richards, formerly dean of the College of Engineering, University of Illinois, was inaugurated president of Lehigh University on Saturday, Oct. 14, in the presence of many delegates from other educational institutions. In his inaugural address President Richards indicated that Lehigh would embark on the work of engineering research. Dr. Richards was born in Clarkshill, Ind., in 1871 and attended Purdue University. He received the degree of M. E. in 1891 and four years later the M. M. E. degree from Cornell University. In 1891 Dr. Richards joined the staff of the Colorado Agricultural College as instructor in mechanical engineering. It was in 1911 that he became associated with the University of Illinois as professor of mechanical engineering in charge of the department. From 1913 to 1915 he was acting dean of the college of engineering and acting director of the engineering experimental station. Later he became dean and director.

Empire State Association's New President

M. J. Brayton, the new president of the Empire State Gas and Electric Association, is one of the pioneers in the electrical industry in New York State and has been continuously associated with the Utica Gas & Electric Company and one of its predecessor companies since Jan. 1, 1889. Mr. Brayton was born in Poland, near Utica, N. Y., July 20, 1852, and was educated in the old Fairfield Military Academy and Whitestown Seminary, both of which institutions in the days of their existence enjoyed a high reputation.

Mr. Brayton became associated with the Utica Electric Light Company in 1889, soon after its organization, as

M. J. BRAYTON

director, secretary-treasurer and general manager. In 1899 the company was reorganized as the Utica Electric Light & Power Company, and it was merged into the Utica Gas & Electric Company in 1902. Mr. Brayton was largely responsible for the building of the company's station at Trenton Falls, which was among the earlier hydro-electric developments in the United States.

On the organization of the Utica Gas & Electric Company in 1902 Mr. Brayton became a director and general manager of its electric department. He was elected secretary in 1904 and was made a vice-president in 1920.

Mr. Brayton was one of the organizers of the Empire State Gas and Electric Association, has served almost continuously on its executive committee since its organization, was president of the association in 1911 and has always been active in its counsels.

Harry Sessions of the Southern California Edison Company is visiting various industrial centers in the East where important equipment is being manufactured for his company. He will spend several months gathering economic data on the installation and operation of power-plant equipment.

Thomas N. Wynne, superintendent of the Indianapolis Light & Heat Company, recently was elected president of the Indianapolis Optimists' Club.

Fred H. Fowler, district engineer for the United States Forest Service in California and Nevada, has resigned to open an office in San Francisco as a consulting engineer.

W. F. Raber, general manager of the Southern Colorado Power Company, has been appointed a member of the board of directors of the Pueblo flood conservancy district.

W. J. Delles was recently appointed executive engineer of the turbine engineering department of the General Electric Company at Schenectady and O. Junggren was appointed consulting engineer.

J. N. Shannahan, president of the Newport News & Hampton Railway, Gas & Electric Company, Hampton, Va., was elected second vice-president of the American Electric Railway Association at the convention in Chicago.

Lewis B. Newell, formerly general manager of the Automatic Illuminated Advertising Corporation, New York, has become associated with the sales department of Hoagland, Allum & Company, Inc., New York.

Victor J. Shear, who for the past eighteen years has had a large and varied experience in the electrical supply line, is now assistant to George A. Lichtenstein, head of the Garfield Electrical Supply Company, New York City.

P. Rabon, who has been with the Frank Adam Electric Company, St. Louis, for a number of years, has taken over the Chicago territory of that company and has also become associated with the Major Equipment Company, Chicago.

Harry D. Randall, Rocky Mountain manager for the General Electric Company, has been elected chairman of the committee to develop outside territory for the Denver Electrical Co-operative League, which is intended to include almost the entire State of Colorado.

G. E. P. Smith, irrigation engineer of the Arizona agricultural experiment station, Tucson, is co-operating with the United States Geological Survey in the preparation of a report on the water resources of San Pedro Valley, Arizona.

Joseph H. Stewart, formerly superintendent of the municipal water, light and heat plant at Goshen, Ind., has been engaged as manager of the Delphos (Ohio) plant owned by the Northwestern Ohio Electric Company. Mr. Stewart had been in Goshen about three years.

Paul H. Diver, associated with the Ohio Electric & Controller Company, Cleveland, as sales representative for four years, has been appointed manager of sales. C. J. Pagel, associated with the Robbins & Myers Company in the Cleveland district, has become sales representative of the Ohio Electric & Controller Company.

Saling H. Wolfe, formerly with the Western Radio Electric Company and radio instructor in the United States Navy for a year and a half, is now specialty salesman in charge of the radio department of the Pacific States Electric Company's Los Angeles office.

A. M. Bohnert, for the past three years high-tension sales engineer for the Ohio Brass Company in the East, has been appointed representative of that company in the Intermountain district, with headquarters in Salt Lake City. Before his connection with the Ohio Brass Company Mr. Bohnert was in the engineering department of the Pacific Gas & Electric Company.

A. J. Moan, Pacific Coast representative of the Johns-Pratt Company of Hartford, Conn., has opened offices at 530 Call Building, San Francisco. The Johns-Pratt Company has recently separated its activities from the H. W. Johns-Manville Company and in the future will operate as a separate unit in so far as distributing activities are concerned. Mr. Moan will have charge of the Pacific Coast territory.

G. P. Atkinson has recently been appointed representative at Atlanta of the Electric Power Equipment Corporation of Philadelphia. In addition to his association with the "Elpeco," Mr. Atkinson is handling the material of the Ward Leonard Electric Company and the Weston Electrical Instrument Company. Previous to going into business for himself he was connected for five years with the latter company at Newark, N. J.

Rufus G. Gentry, commercial manager of the Denver Gas & Electric Light Company, was re-elected treasurer of the Colorado Merchants and Manufacturers' Association at the annual convention of that organization recently held at Sterling, Colo. Mr. Gentry is one of the incorporators of the Colorado Industrial Exposition and Prosperity Carnival, which will be held in Denver next February.

Warren Stoutnor, a member of the Public Utilities Commission of Utah, has returned to Salt Lake City after attending the accounting conference held in Washington, D. C., between the executive secretary of the Federal Power Board, on the one hand, and state commissioners and public utility executives, on the other. Mr. Stoutner is chairman of the special committee representing the National Association of Railway and Utilities Commissioners in this matter.

Albert Lyle Chavannes has recently been appointed instructor in the department of electrical engineering of the University of Illinois. He was graduated in 1918 with the degree of B. S. in electrical engineering from the University of Tennessee, where he has been instructor in mathematics and mechanics since September, 1919. Mr. Chavannes was connected for a short time with the Westinghouse Electric & Manufacturing Company as production clerk at East Pittsburgh.

H. R. Eilertsen has resigned as electrical engineer of R. Hoe & Company, New York, and is now sales engineer with the Cutler-Hammer Manufacturing Company, printing equipment department, New York. Mr. Eilertsen will specialize in the electrical problems associated with the small accessory machinery used in the printing industry.

Robert E. S. Pope has been appointed engineer and superintendent of the Electric Motor Repair Company, Springfield, Mass. Mr. Pope was graduated from the Worcester (Mass.) Polytechnic Institute in 1910 and received the degree of electrical engineer from that institution in 1912. For the past ten years he has been associated with the Crocker-Wheeler Company, Ampere, N. J., as test foreman, erector, superintendent of erection, and more recently as a designing engineer.

F. M. Webber, who for the past three years has conducted an electrical appliance business in Philadelphia, has joined the Robbins & Myers Company as assistant sales manager in charge of motor sales, filling the place vacated by A. J. Reed, recently resigned. For sixteen years Mr. Webber was connected with the General Electric Company, entering the Fort Wayne works in 1903, and from 1913 to 1919 he was apparatus sales manager at St. Louis.

N. G. Hardy has been selected to succeed R. H. Forney as chief engineer of the Waco generating station of the Texas Power & Light Company. Mr. Hardy was graduated from Rensselaer Polytechnic Institute in 1910 and then spent eight years in power-plant work with copper companies in Mexico and Arizona. In 1918 he became associated with the Du Pont Engineering Company and later returned to the Arizona Copper Company at Clifton, Ariz., as chief engineer of construction and operation for the electrical power system. Mr. Forney resigned this post to become associated with the Dallas Power & Light Company.

Obituary

John Forrest Kelly, an electrical engineer and a pioneer in electrical research, died recently at his home in Pittsfield, Mass. In 1879, the year after his graduation from the Stevens Institute of Technology, Mr. Kelly was employed in Thomas A. Edison's laboratory, and after a number of years in the employ of the Westinghouse Electric Lighting Company, Newark, N. J., he went to Pittsfield as consulting engineer for the Stanley General Insulating Company, which later became the Pittsfield works of the General Electric Company. He received more than eighty patents on devices for generating, transmitting and distributing electricity and was a pioneer in high-tension transmission.

Manufacturing and Markets

Devoted to the Discussion of Business and Economic Problems of the Producer and Distributor, with Market Reports, Trade Activities, Foreign and Construction News

Swindlers Angling for American Motors

Large-Scale Operation Baited with Cash-in-Advance Letters of Credit on Fictitious Greek Bank a Menace to Manufacturers—Warning from Electric Power Club

INTERESTING evidence of the need for vigilance in trading with the distracted areas of eastern Europe at the present time has been submitted by the Century Electric Company of St. Louis for the information and guidance of other electrical manufacturers engaged in export business. About a month ago the export department of the Century company received a letter of credit from the "Credit Bank of Piræus, Greece." As the accompanying reproduction shows, it was impressive in appearance. It carried the number 141,578, bore numerous stamp imprints and signatures and counter-signatures in various styles of ink, with all the atmosphere of the foreign banker's traditional style. It read as follows:

Century Electric Company,
St. Louis, Mo.

GENTLEMEN: We request you to please take note that we have at your disposition and from the Société de Constructions Industrielles et Représentations the sum of $20,000 (twenty thousand dollars) against presentation of the shipping documents as follows:

Complete set of bill of lading to order,
Invoice and certificate of origin,
Policy of insurance covering marine and war risks,

for a shipment of engines (motors) for the above amount, to be shipped to Piræus with destination to Athens.

This credit memorandum will be paid if the documents are sent to us direct from this date, August 16, 1922, to September 30, 1922.

We request you to please send the documents as above stated and by registered mail and charging us the exact transportation charges to C.I.F. Piræus, mentioning in your letter the charge under the number of the present memo. The present credit is identical to the one which we cabled to you as per copy.

P. S.—Kindly take note that the Ministry has authorized the transfer of the money abroad, but only after the goods have been landed and delivered in Greece.

Stamped on the corner of the document was this further statement:

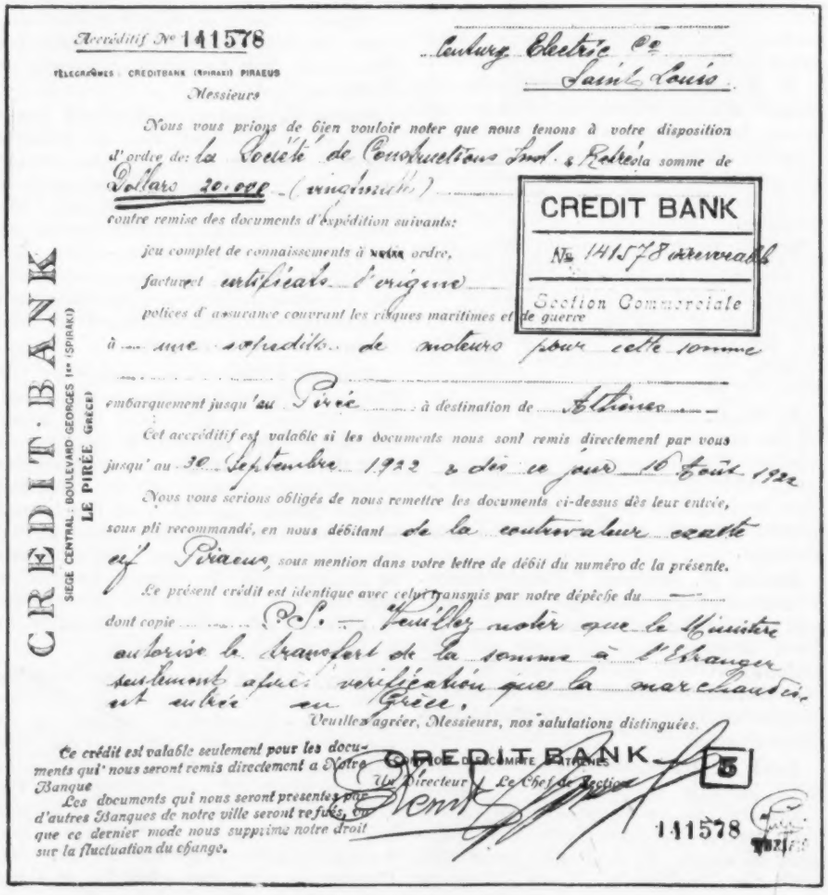
This credit is valid only for documents which are to be sent to us direct through our bank.

Documents which will be presented to us by other banks of this city will be refused, as such presentation is prejudicial to our rights in connection with exchange fluctuations.

The communication bore every appearance of a valid letter of credit, and a letter of credit offering cash in advance is a dainty morsel that appeals to the eye of any manufacturer who sees the prospect of business development in the export field and is on the watch for opportunities to establish new connections in fresh fields that he has not yet touched. But the translator had heard a rumor of the activities of the "Credit Bank" and added this note:

I would suggest that you investigate this matter thoroughly because this Credit Bank has been sending numerous memorandums of credit to different American manufacturers, and besides I do not think that there are 20,000 gold dollars in Greece.

An investigation was made, and it turned up the interesting information that the "Credit Bank of Piræus" was non-existent and the mental creation of a set of swindlers, who had been discovered in a purely accidental way. A firm of exporters in New York that has been seeking a market for automobiles and automobile supplies in the Near East had



Accréditif N° 141578

Century Electric Co
Saint Louis

TÉLÉGRAMMES : CREDITBANK (PIRAEUS) PIRAEUS

Messieurs

Nous vous prions de bien vouloir noter que nous tenons à votre disposition d'ordre de: la Société de Constructions Ind. & Repré la somme de Dollars 20.000 (vingt mille)

CREDIT BANK
N° 141578 accréditif
Section Commerciale

contre remise des documents d'expédition suivants:

jeu complet de connaissements à ordre,
facture et certificats d'origine
polices d'assurance couvrant les risques maritimes et de guerre

à une cargaison de moteurs pour cette somme

embarquement jusqu'au Pirée à destination de Athènes

Cet accréditif est valable si les documents nous sont remis directement par vous jusqu'au 30 Septembre 1922 à dix ce jour 16 Août 1922

Nous vous serions obligés de nous remettre les documents ci-dessus dès leur entrée, sous pli recommandé, en nous débitant de la contre-valeur exacte en Piraeus, sous mention dans votre lettre de débit du numéro de la présente.

Le présent crédit est identique avec celui transmis par notre dépêche du
dont copie

P.S. — Veuillez noter que le Ministre autorise le transfert de la somme à l'étranger seulement après vérification que la marchandise est entrée en Grèce.

Veuillez agréer, Messieurs, nos salutations distinguées.

CREDIT BANK

Le Directeur — Le Chef de Section

Ce crédit est valable seulement pour les documents qui nous seront remis directement a Notre Banque

Les documents qui nous seront presentés par d'autres Banques de notre ville seront refusés, car ce dernier mode nous supprime notre droit sur la fluctuation du change.

141578

CREDIT · BANK
SIÈGE CENTRAL : BOULEVARD GEORGES 1er (PIRAEUS)
LE PIRÉE (GRÈCE)

A BOGUS LETTER OF CREDIT USED IN EFFORT TO BUY MOTORS

been advertising in foreign journals. The swindler, noting the name, sent them a letter of credit for $8,000 identical with the one received by the Century company and an order for six motor cars to be shipped against this sum of money deposited in the "Credit Bank of Piræus." By the same mail came a letter from the "International Bank of Piræus, Greece," Foreign Trade Department, marked urgent and reading:

GENTLEMEN: We beg to advise you that the letter of credit deposited with us to your order having expired (No. 21,618), we have transferred under the instructions of our customer the sum of $6,900 to your order, to the Banque de Credit (Credit Bank), Boulevard Georges I (Spiraki), Piræus, to which you are requested to send your instructions up to October 20, 1922, together with shipping documents, with copies by the next mail following to this bank, advising us at the same time.

If in the meanwhile we should receive documents sent to us direct, we will return them to you in due course.

NAME UNKNOWN ABROAD

But the men behind the swindle also sent similar orders and credit letters to several other automobile manufacturers, and by chance one of these direct orders came to the desk of the manufacturer's export manager on the same day that he received a similar order and letter of credit through his New York export agent. This, of course, was too striking a coincidence to pass unnoticed, and a careful inquiry was made by cable to authorities abroad and brought this reply:

Re International Bank Piræus, and Société de Constructions Industrielles et Représentations, Athens, Greece.

The above-named firms do not exist in our city. This is a mere malevolent fiction on the part of a certain Ch. Theodoridis, who after having cheated banks and commercial houses, was pursued by justice and imprisonment.

So the automobiles were not shipped and neither were the motors, but in all probability goods have been delivered and lost under some of these credits. For the document looks authentic, the corroboration from another bank strengthens the impression, as does also the ingenious rubber stamp that instructs the shipper not to send documents through any other Piræus bank on account of the exchange situation. Every one knows that exchange is jumbled and it might well be to the benefit of the bank to receive the papers direct. But these are uncertain times and it pays to be careful. American electrical goods are needed abroad and there is opportunity for profitable foreign trade, but it is not safe to take any order, any letter of credit or any bank as security for goods unless the house is known. Therefore, basing its action on this case, the Electric Power Club has just sent out to all its members the following warning:

Any member receiving orders and letters of credit from Greece should scrutinize them very carefully, as it has come to our notice that some letters of credit have been received in this country that have been issued by swindlers.

The Meaning of Simplification

The Relation of the Elimination of Excess Varieties to the Development of New Products—Primarily a Commercial Activity

THERE has been considerable discussion and uncertainty in various quarters in reference to just what "simplification" means as it applies to the program of the United States Department of Commerce and the activities which have been carried on under that name in many industries.

The feeling has been voiced by some manufacturers that to urge upon them the simplification of their lines by the elimination of excess varieties would be an unwarranted interference with their freedom of action in a competitive market and that any general application of the principle would act as an obstacle to the development of new varieties and the progress of manufacture.

As a result of several conferences between Secretary Hoover and W. A. Durgin of the Division of Simplified Practice and representatives of the electrical industry there has been evolved this statement, which is clearly the conception of the department on the subject:

"It would be difficult to give a clear definition of simplification, but the underlying principle of simplification is the elimination of excess varieties of manufactured products in regard to already existing varieties and in no way affects the development of new varieties."

Regarding this Mr. Durgin also writes:

"I believe it is quite safe to use that definition in addressing any electrical group, but I hesitate to make it a final definition. You will appreciate that with a somewhat hazy idea at the back of this movement it is hardly wise to limit possible developments by fixing a rigid definition at the start. That is my only fear in this connection. In so far as my own vision goes, I would say that simplified practice may well mean any activity suggested by the words which industry may care to undertake.

"I am just trying to recognize the very probable limitation of our present vision. At any rate, there is now no thought, nor can there ever be any thought, of simplified practice limiting, restricting or even directing development in any art. This is as far removed from the prevalent conception of standardization as is the viewpoint of the futurist painter."

As a result of this definition it seems entirely clear that "simplification" is primarily a commercial activity, although it possibly affects the manufacturers of various products to a greater extent than any other of the parties at interest. Therefore simplification has the practical purpose of eliminating excess varieties of manufactured products, through agreement between the parties at interest and the United States Department of Commerce to discontinue the manufacture and sale of such excess varieties after conferences between the manufacturers and other parties at interest with a view to determining just what excess varieties should be eliminated to conserve the best interests of the public as well as the manufacturers and those who distribute and sell them.

There has been some confusion as to the question of whether engineering standardization is to be a part of simplification. During these conferences it may be necessary for the manufacturers and others to discuss engineering standards, but the final agreement which brings about simplification is not an engineering matter, and such conferences, it is felt, should not change or set up new engineering standards.

It is generally recognized that engineering standards should be prepared either by an industrial organization or by a special committee of

the American Engineering Standards Committee, after which the standard becomes a recognized American standard. Therefore, in so far as engineering standards are concerned, the American Engineering Standards Committee, probably should have representation in the various simplification conferences.

Simplification in itself presupposes the existence of certain commercial standards of sizes, styles, types and varieties or it indicates a lack of similar commercial standards in an industry.

Broadly the aim of simplification is to eliminate waste, and it has been a matter of keen interest since the survey of six typical industries by the Federated American Engineering Society developed the fact that at least 40 per cent of the effort, investment and energy expended by these industries was absolute waste, which meant that, with a liberal discount to make allowance for the zeal of the specialized investigator, fully 25 per cent of our industrial activity is being wasted and a considerable proportion of this waste is said to be attributable to lack of standardization. How this occurs was indicated significantly in a recent address by Mr. Durgin in these words:

"In all sorts of lines the plea is: 'We are making altogether too many sizes and styles. Our sales department is leading us by the nose! Instead of going down to Texas and selling the thing we make, they can only find the customer who thinks he wants something just a little bit different, and then they make life miserable until we produce that different thing.' As a result of this diversification each group in the industrial structure is suffering—not only the manufacturer, but the wholesaler and the retailer, and indeed when it comes to maintenance, replacement and repair, the ultimate user. The diseases that come from excess variety are evident enough. Stocks and investment are needlessly extended, turnover is decreased, and cost of production is run up in each of numberless varieties. Deliveries are delayed and time is lost in getting the item ordered. It is unsafe to accumulate stocks during slack periods, for no man can predict just what variety will be demanded when the boom appears. All the wastes attendant on indecision in production and use are prevalent. Selling expense is boosted to a maximum in covering these tremendously extended varieties. Misunderstandings and misrepresentations are unavoidable, and there is little fundamental investigation and development of basic lines as it is so much simpler to change trifling details and start a new variety, while foreign commerce goes to foreign producers of simplified merchandise."

All these diseases have been known, of course, for many years, but the stress of war was needed to focus the attention of industry and develop a true remedy. The opportunity to profit by simplification in some lines in the electrical industry is marked and it is most important that the purpose of the movement be understood and sympathetically furthered.

Survey of Business Conditions

Failures Show Small Increase

Despite the fact of a five-day business week in the United States owing to an observance of the holiday, failures reported to R. G. Dun & Co. show a small increase, being 390 for this week, as against 383 in the six-day business week preceding. The total for the corresponding week in 1921 was 375. Defaults with liabilities of more than $5,000 in each case number 208 this week, being one less than were reported last week. They are also a slightly smaller proportion of the total, amounting to 53.3 per cent this week, as against 54.5 per cent last week. A year ago similar insolvencies numbered 232, being 61.8 per cent of the total.

Imports of Radio from Germany Totaled $23,202

An analysis of imports at New York by the Department of Commerce shows that the imports of electrical goods are steadily increasing. During September electrical goods valued at $103,283 were entered at New York. It is estimated that 90 per cent of the imports of electrical goods are made through that port. By countries the totals are as follows: Germany, $59,862; France, $21,687; England, $14,486; Czechoslovakia, $4,670; all other countries, $2,558. Wireless apparatus heads the list. During September Germany sent $23,202 worth of wireless apparatus to this country; England, $8,650, and France, $5,440. Carbons came next, Germany furnishing $10,823 and France $12,112. The detailed figures are given in the accompanying table.

Expect Good Christmas-Tree Lighting Set Business

Business in Christmas-tree lighting sets during November and December promises to be the best in years, according to dealers and manufacturers in the Eastern territory. It is said that the situation is particularly satisfactory to the manufacturers because of the low stocks left over in the jobbers' and dealers' hands from last year. Dealers in the New York territory are expressing active interest, and business in this line is expected to open up fully around the first of December.

American Interests Meeting Brisk Competition in China

American electrical interests are meeting with energetic competition from German companies in the China field. Several contracts on which Americans bid were awarded to either the Siemens China, Ltd., or the A. E. G. The fact that both of these German interests are in this field is disconcerting to American interests, because with the A. E. G. and Siemens bidding on the same job, prices are cut much more than would be the case if only one German firm were bidding against British and American interests.

PRELIMINARY FIGURES OF ELECTRICAL IMPORTS THROUGH NEW YORK, SEPT., 1922

	Germany	France	England	Czecho-slovakia	All Other Countries
Carbons	$10,823	$12,112	.....	.....	.....
Lighting fixtures	5,466	3,160	$315	$3,803	.....
Wireless apparatus	23,202	5,440	8,650	.....	$165
Arc lamps	59	.....	350	.....	.....
Electric irons	9,241	.....	.....	.....	.....
Telephone parts	1,136	.....	.....	.....	.....
Household appliances	418	.....	4,850	.....	.....
Batteries	58	.....	.....	.....	.....
Electric hair driers	2,851	.....	.....	.....	.....
Electric fans	11	.....	.....	.....	.....
Water heaters	507	.....	.....	.....	.....
Perfume burners	1,600	.....	.....	.....	.....
Push-buttons and bells	55	.....	.....	.....	35
Flashlights	895	.....	21	.....	.....
Table lamps	1,540	975	.....	867	2,355
Miscellaneous	2,000	.....	300	.....	3
Total	$59,862	$21,687	$14,486	$4,670	$2,558
Total from all countries					$103,263

Improving Demand in Foreign Lands

Heavy Imports of Cables, Turbines, Lamps and Motors by Manchuria —Promising Market for Automatic Telephone Systems in Australia

THE demand for electrical products is increasing in Europe and Asia, according to reports received last week. Trade statistics of Manchuria show electrical imports for 1921 valued at 2,470,089 Haikwan taels, compared with 1,862,136 Haikwan taels in 1920. Expressed in dollars, the 1921 imports were as follows:

Cables, wire and cord	$404,633
Turbines, etc.	338,010
Lamps and lampware	207,441
Motors and parts	180,323
Transformers	164,239
Batteries and dry cells	73,235
Switches	41,691
Insulators and porcelain cleats	31,030
Miscellaneous goods	436,665
Total	$1,877,267

The average value of the Haikwan tael in 1920 was $1.25; in 1921 it was $0.76. Most of the imports were through the port of Dairen and were largely for the South Manchuria Railway. America, Japan and England furnished each about a third of the imports.

Interest in Automatic Phones

An improvement in the automatic telephone market is seen in recent activities in Melbourne and the surrounding territory. Members of the Australian Federal Public Works Committee are expected to recommend to Parliament the installation of automatic telephone exchanges at Box Hill, Canterbury and South Melbourne, following an inquiry which considered the necessity for making such improvements in order to reduce operating costs and effect new installations for subscribers. The erection of these exchanges is part of a scheme to establish a system of automatic exchanges throughout the metropolitan area, several of the subdivisions of Melbourne already having automatic exchanges.

Late cable advices from Paris received by the Department of Commerce indicate that French electrical equipment factories are active and manufacturers are even preparing for more business in the future. A rapid development in the use of electricity is taking place in France, and extensive water-power projects now contemplated are expected to be soon under way.

By a royal decree dated July 16, 1922, published in the Rome *Gazzetta Ufficiale*, funds are appropriated for the purpose of fitting up a building in the central part of Rome as a new automatic telephone exchange, says Consul Russell in a report to the Department of Commerce.

Outdoor and indoor switchgear for the Khundallah substation of the Mangahao power scheme is being purchased by the Public Works Board of Wellington, N. Z. Tenders for this material, including supervision of the erection and testing, will be received by the Public Works Tender Board at Wellington on Nov. 28 next.

This substation will receive power from two overhead three-phase transmission lines at 110,000 volts, 50 cycles, delivered to two banks of single-phase transformers, each of 12,000 kva. capacity, the voltage being 11,000.

Possibilities in Esthonia

Consul Albrecht, Reval, reports to the Department of Commerce that electrical machinery and other products obtained from Germany at present are reported as being very frequently of inferior quality. Furthermore, it is stated that no assurances can be obtained as to price or time of delivery with reference to such goods, which generally are received at a much later period and cost considerably more than anticipated, even when allowing for the falling rate of exchange. Under these circumstances Esthonian firms are said to be transferring their orders to Sweden and Great Britain, from which countries they can obtain articles of good quality at a previously fixed price with delivery at a definite time.

Indications are, the consul says, that American manufacturers might do business here with the local factories if the latter had fuller information as to their products, prices, terms of sale and delivery, and time required for the latter. No doubt, many manufacturers of machinery and products of this character have representatives in Europe from whom this information could be obtained without the delay attendant upon communication with the United States, but in general neither the local factories nor the consuls have been informed of their names and addresses.

Except for one woodworking factory which placed important orders for American machinery as a result of a business trip of its representative to the United States, it is believed that none of the larger factories here has ordered any machinery from the United States since the war, and they are in general out of touch with manufacturers there.

Soft Coal Shipments Are Increasing

Although the aggregate shipments of soft coal have increased gradually during September, the shipments from individual producing districts have fluctuated irregularly. A government table showing by districts the average daily shipments for the last three weeks in September and the daily shipments for the first three working days of October indicates that in Pennsylvania there was a slight decrease each week since Sept. 9, and that the week of Oct. 5 was begun with shipments at a lower rate than the previous week. In Maryland and part of northern West Virginia there has been a steady increase, but in southern West Virginia there has been a steady decline. In Kentucky there was little or no change up to the present week, for which, however, a decline is indicated. In Alabama daily shipments have been falling off since the close of the first week of September. In Ohio, Indiana and Illinois there have been gradual gains up to this week, which now appear to be checked. West of the Mississippi shipments have in the main steadily increased.

The Metal Market

Copper and Zinc More Quiet Than Usual—Importers Have Fairly Large Stocks

Copper and zinc have been more quiet than usual during the last week; lead has been in the normal good demand, and tin has been active at advancing prices. The market for the minor metals, minerals and ores cannot be said to be established as yet, because of the dislocation caused by the tariff. Many importers have fairly large stocks on hand that were brought into the country with the expectation of a tariff advance, and these are being released at prices which represent all the way from a fair profit on the purchase price to a figure which takes full advantage of the tariff advance. Fundamental business conditions in the country continue good, and the next few months should see an improvement in the fuel supply and transportation conditions, facts which should have a favorable effect on the metal markets. Many mining companies are seriously affected by a labor shortage which will tend to cut down production but at the same time, by restricting the supply, will increase the price of metals.

Copper is distinctly weaker. Sales have been very unsatisfactory during the last few days, though consumers of the metal are in general working to capacity, and it is felt that the present lull can therefore be no more than a temporary one. As most producers are well sold up, there has been no great pressure of metal on the market, but a slight tendency to a price recession can be observed. Most of the large producers, if not all, are holding at 14 cents, delivered, and in the last week have sold possibly 25 per cent of their normal business. They seem willing to book business somewhat further ahead than usual. There are persistent rumors to the effect that large consumers have had plenty of copper offered to them at 13¾ cents, delivered, even to Connecticut Valley points, but it is difficult to find a producer who will acknowledge having shared in this business except to points near New York where the freight rate is around 15 cents per 100 lb. Several orders of this nature have been placed, however, which are reflected in quotations, this being the first quotational break in the 13.75 cent refinery figure since Sept. 1.

The Week in Trade

Prices When Quoted Are Those Reported at the Opening of Business on Monday of This Week for Points West of the Mississippi River and on Tuesday for All Eastern Points

WARMER weather during the last few days has caused a slight falling off in the sales of heaters, and this let-up has allowed jobbers and dealers time to make replacements of the stocks disposed of so quickly during the past few weeks. Cleveland reports that conduit stocks are now around normal and that prices are again firm. The business of the central stations is far above that of a year ago. Fixtures are selling actively throughout the country owing to completion of much construction. Record buying of appliances during the holidays is expected by most of the jobbers. Collections generally are satisfactory.

Boston

Demand for Vehicle Batteries Taxing Deliveries—Wire Sales Excellent—Fixtures Meeting Requirements

Business conditions are better, with few exceptions, week by week. Textiles are resuming production, central-station expansion is continuous, jobbers are more active and retail electrical sales picking up. Prices are firm, with a decided stiffening tendency in sockets. Deliveries are uneven. Building operations are progressing rapidly, and electrical manufacturing in New England is far ahead of a year ago. Financial conditions are easier. Plans are being made for a record-breaking holiday trade.

Storage Batteries.—The demand for vehicle and truck batteries is taxing deliveries more than for a long time. Radio batteries are not as yet in heavy demand. Prices are firm.

Wire.—Sales are in excellent volume. Rubber-covered No. 14 wire is moving steadily at $6.25 per 1,000 ft. in 5,000-ft. lots. Outside construction is absorbing fair quantities of weatherproof and some bare copper is being sold for radio aërials.

Sockets.—A price advance of about 7½ per cent was expected early in the present week, putting "pulls" in case lots on a 33⅓-cent basis, net, "keys" at about 22 cents and keyless sockets at about 19½ cents. New schedules had not been made out Monday by local jobbers, but the advance was expected by Tuesday.

Lamps.—Sales are improving rapidly. Stocks are meeting current needs and are heavier. The recent reductions in higher-wattage lamps have led to increased interest in this trade. New England textile mills are ordering more freely as a result of resuming operations after protracted strikes.

Fixtures.—Stocks are easily meeting present requirements, notwithstanding talk to the contrary. Active sales are apparent, notably in portables. Residential and commercial installations are absorbing much more material than earlier in the year.

Rigid Conduit.—Much improvement in local stocks is reported. Incoming shipments and a slight falling off in the demand for larger sizes are responsible for this condition of affairs. Prices are firm.

Heaters.— Milder weather has given the trade a little chance to catch up in part on orders. The resumption of coal deliveries has carried the public past emergency heater buying for the time being. Substantial sales based on emphasizing the convenience and economy of short-time heater operation are still anticipated for the remainder of the fall.

New York

Greater Business in Appliances—Collections Easier—Warmer Weather Slows Heater Sales

Business continues to improve, greater activity is reported in appliance sales, and central-station outputs are much more than a year ago. The conduit market is steadied by better stocks, and prices generally are firm for the smaller sizes. Dealers' business is picking up and jobbers report greater activity all along the line. Collections are easier.

Heaters.—The warmer weather during the last week has done much to slow down the active demand reported for the week before. Greater activity is seen among the manufacturers and jobbers, and dealers are stocking up in fair amounts to be ready for the late fall and winter business, which is expected to be record-breaking. Prices generally are even.

Fixtures.—Present requirements are met easily with good stocks. Portable lamps are selling best, and the recently constructed houses are taking heavy amounts of all kinds.

Lamps.—Demand is better and stocks on hand are ample. Increased interest is evident after the recent price reductions in the higher wattages. Much replacement business is being done.

Motors.—Demand has switched to the smaller sizes. Stocks are reported fair and prices firm. Second-hand dealers are receiving a large amount of the orders.

Cleveland

Jobbers Confronted with Shortage of Heaters—Washers Have Favorable Week—Prices Firm

With relief of the conduit shortage in sight, jobbers are now confronted with a shortage of heaters. Dealers are able to supply the present demand from the stocks of those jobbers who made capital from the stock phrase of the conservative faction which met all speculative suggestions with, "It's going to be a long, cold winter."

Lamps.—Dealers and jobbers report a fair activity in the sale of ordinary sizes. Declining prices have had a tendency to retard orders slightly, but stocks are good. It is indicated that building will continue throughout the mild weather, and a prolonged lamp and fixture market is generally expected.

Heaters.—Small portable heaters of popular makes were the feature of this week. Dealers report heavy demand and greatly reduced stocks, although deliveries have been fair, and jobbers are continuing to accept orders for fall delivery. Prices have stiffened slightly.

Radio Equipment.—Much improvement in equipment sales is considered responsible for the general optimism among jobbers and dealers. It seems the consensus of opinion among the dealers that consumers have graduated beyond the experimental stage and are now demanding that better equipment be supplied.

Washers.—A favorable week is reported and receipts are far above expectations. Dealers will concentrate on moving out the present supply during the coming week.

Appliances. — Keen competition for the holiday trade is already noticeable. No estimate has been placed as yet upon the holiday sales other than that a record-breaking season is expected.

Motors.—Movement to the smaller type has been invigorated with better shipments during the week. Prices are firm.

Chicago

Lamp Sales Are Active—High-Tension Equipment Demand Is Brisk—Fall Radio Call Starting

Business in the electrical trade is moving steadily upward. Reports from jobbers indicate that the call for wiring materials is active and that shipments from manufacturers are varied because of the scarcity of freight cars. The conduit situation remains unchanged, with spotted supplies and a very active demand.

The sale of lamps for railroads and industrials is brisk. Prices on certain types were reduced about 20 per cent on Oct. 1. Movement of high-tension equipment is active, all companies reporting large sales. Interest in radio is better and dealers feel that fall business will be good.

Wire.—Call for rubber-covered wire is continuing at a steady rate. No. 14 is quoted at $6.25 to $6.30 per 1,000 ft. in lots of 5,000 ft. Stocks are fair. Bare and weatherproof wire is moving slowly at 16¾ cents per pound.

Conduit.—The ten-day freight embargo has not helped the conduit situation in Chicago since stocks are spotted and the demand very active. The ½-in. black pipe sells for $55 per 1,000 ft. in lots of 5,000 ft.

Flexible Armored Conductor. — Demand for armored conductor is steady. The No. 14 two-wire, single-strip conductor is available in 5,000-ft. lots for $48 per 1,000 ft. Stocks are normal.

High-Tension Equipment.—Orders for this equipment are steadily coming in. One manufacturer received orders for one 9,000-kva., 66,000-volt outdoor substation for the West and sixteen 44,000-volt substations with capacities ranging from 600 kva. to 3,000 kva. Other companies report that their standard equipment is moving well.

Lamps.—Fall buying of lamps by railroads and industrial plants has started and is progressing well. Price reductions Oct. 1 on railroad, round bulbs and miniature types range between 20 and 25 per cent. Larger sizes of the "Mazda C" were also affected by this reduction. Stocks are good.

Schedule Material.—The steady call for this material is due to the active building construction. Prices have remained stationary. Pull sockets sell for $33 per 100, key sockets for $18.15 and the keyless for $16.50 per 100 in standard packages.

Radio.—With the coming of cooler weather, radio has started to return to popularity. Dealers have good stocks on hand and expect good sales during the winter.

Atlanta

Heater Business Fair—Stocks of Outlet Boxes Good—Brisk Movement of Telephones

Practically all of the railroads have lifted embargoes on freight shipments and are accepting freight in the regular routine way, although there are still one or two roads accepting freight shipments, subject to delay. Electrical business as a whole reports very fair activities throughout the entire line, and it is predicted that a number of firms that have stocked heavily on radio equipment are going to find themselves with top-heavy inventories the first of the year.

Air Heaters.—Movement is fairly good with a tendency on the part of a number of firms to cut prices in order to clear out stocks and prevent carry-overs. Stocks are in good shape, shipments satisfactory and deliveries fair.

Meters.—A fairly good volume of sales is reported. The 5-amp. two-wire type constitutes 80 per cent of the volume with 10-amp. two-wire second. There is a tendency to use the 15-amp. size for range purposes as a substitute for the 25-amp. size. Good stocks are on hand and shipments are satisfactory.

Outlet Boxes.—Building construction continues to take this article in large volume. While stocks still are good and factory shipments satisfactory, freight deliveries are not all that might be desired. Prices are steady.

Telephone Equipment.—An unusually good movement of P. B. X. and interphone equipment is reported, with other lines of standard telephone equipment moving fairly well. Prices are steady, with stocks and shipments satisfactory.

Cross-Arms.—Very good sales are reported with the anticipation of fall extensions and winter replacements. Ample stocks are on hand. Prices steady.

Sewing Machines. — Disappointment in volume of sales continues, the fall season failing to revive this line. Jobbers have good to heavy stocks, but have not made any general price reductions.

Denver

Hollow-Ware Supplies Ample—Preference Given to Standard Heaters —Wiring Devices Active

Competition between electrical contractors is still severe, but improvement is noticed. Department stores and electric shops have an ample supply of hollow ware on hand. Medium-priced pot percolators lead in demand.

Radiant Heaters.—Frosty mornings and cool days have developed interest in all types of air heaters. Jobbers and dealers report increasing demand. Preference is being given to standard heaters.

Porcelain.—Three carloads ordered some weeks ago are expected daily. A shortage is found in most jobbers' stocks due to transportation delay. Knob and tube orders from outside territory are still holding up.

Conduit.—Smaller jobbers report considerable business with supply greatly improved. The ½-in. loricated is quoted by association jobbers at $56 per 1,000 ft. in lots of 2,500 ft. or over; $58.50 per 1,000 ft. in lots of 500 ft. to 2,500 ft., and $65 for less amounts.

Armored Cable. — Strong demand. Several big sales were reported last week at price of $55 in 1,000-ft. lots.

Wiring Devices.—Splendid business reported by jobbers.

St. Louis

Rubber-Covered Wire Prices Tending Lower—Fuse Business and Stocks Are Good

On the basis of building permits, construction activity is about the same. The value for September is $1,715,117. A year ago the value was $4,307,172, the high amount being due to two million-dollar structures on which the electrical work is now just becoming active. The amount of industrial construction is, however, increasing, being $42,500 in September, 1921, and $107,200 this September. Work is just starting on a tack factory, to cost $1,500,000, but several smaller factory jobs are being postponed until next spring.

Wire.—Prices on No. 14 rubber-covered are tending lower, one jobber quoting $6.20 per 1,000 ft. in 5,000-ft. lots. Other prices run to $6.50 per 1,000 ft. in 5,000-ft. lots. No. 12 is priced from $9.15 to $9.50 per 1,000 ft. and No. 10 from $12 to $12.50 per 1,000 ft., both in 5,000-ft. lots. Stocks are in good condition and demand is steady and active.

Conduit.—There is some improvement in receipts, but stocks continue extremely low. In 1,000-ft. lots ½-in. black is now quoted at $52.60 per 1,000 ft. and ½-in. galvanized is quoted at $60 per 1,000 ft.

Fuses.—Business and stocks are good. Cartridge fuses, 0-amp. to 30-amp., sell from $5.20 to $5.40 per 100 and 31-amp. to 60-amp. from $7.80 to $8.10 per 100, in standard packages.

Flexible Armored Conductor.—A good and active demand is reported, with stocks tending low. No. 14 two-wire, in coil lots of 250 ft., is priced at $4.80 per 100 ft.

Portland-Seattle

Jobbers Report Business Is Good—Unusual Demand Reported for Air Heaters

Business generally is reported in good shape. Lumber production for the week of Oct. 7 was 10 per cent above normal and was 33 per cent above new orders and shipments. Though a slump exists in the demand for lumber from Japan, this is offset by increasing orders from Australia. The grain movement continues steady and cargoes of apples and prunes are beginning to move out.

Electrical jobbers report business to be continuing in good shape. Stocks are ample in every line except conduit. The unusual demand for air heaters in this section has temporarily depleted some stocks. Lumber and pulp mills are active in electrifying at this time, which produces a very good demand for industrial material. An advance of approximately 10 per cent is reported in snap and push-button switches. The demand for farm-lighting outfits is improving, as is also the demand for lamps.

Some Christmas orders for future delivery are being received. Jobbers report collections improving and credits are easing up somewhat. The average period for outstanding accounts for September for the Northwest was forty-nine days. Contractor-dealers report business good, although much wiring work is still being taken on a very close margin. Fixtures are moving more actively than any other line at present. It is reported that new labor has come in to such an extent that apparently no shortage exists in the supply of electrical workers.

San Francisco

Fixture Firms Busy Because of High Tide in Construction—Ranges Active

September was an exceptionally good building month. There are signs that industrial building is increasing. Non-employment is increasing slightly, especially in coast cities.

Fixtures.—All fixture firms are busy because of the high tide in dwelling construction. It has even been thought profitable to establish new firms, necessarily increasing price competition. Fixture designing is playing an important role in the public's mind.

Ranges.—Northern California companies are placing an average of about 150 ranges per month on their lines. This business is spread among a variety of manufacturers.

Activities of the Trade

Devoted to News of the Manufacturer, Jobber, Agent, Contractor and Dealer, Including Important Orders and Contracts for Apparatus and Equipment

Robbins & Meyers Company Gross Sales $2,498,915

The consolidated income account of the Robbins & Myers Company for the six months ended June 30 last shows gross sales of $2,498,915; gross profit, $507,805; profit from operations, $130,446, and operating loss after interest charge, etc., $188,312.

The balance sheet as of June 30 last shows inventories totaling $4,010,404; cash on hand and in banks, $499,355; notes receivable, $61,874; customers' accounts receivable, $41,039,122; notes payable, $1,637,000; accounts payable, $48,706; earned surplus, $243,535, and total assets and liabilities of $13,131,473.

Foxboro Company Opens Boston Office

The Foxboro Company, Inc., Foxboro, Mass., manufacturer of indicating, controlling and recording instruments for temperature, time, flow and motion, has established a branch office at 49 Federal Street, Boston, under the direction of F. G. Hatch.

Rhode Island Electric Heating Organization Expands

C. I. Hayes, manufacturer of industrial electric heating apparatus, has opened a new office at 194 Friendship Street, Providence, R. I., and in addition to various types of electric furnaces, ovens and special industrial heating appliances of his own production has arranged to market the following equipment in southern New England: Berwick electric metal heater, manufactured by the American Car & Foundry Company, Berwick, Pa.; heavy-duty, high-temperature furnaces manufactured by the Hoskins Manufacturing Company, Detroit; electric ovens, Oven Equipment Company, New Haven; General Electric Company industrial heating apparatus, Leeds & Northrup pyrometer and other instrumental equipment. In recent years over 1,000 kw. in Hayes equipment has been added to the lines of the Narragansett Electric Lighting Company alone.

A representative of Mr. Hayes informed the *Electrical World* this week that business is gradually improving in the industrial heating field.

Multi Electrical Company Moves New York Sales Office

The Multi Electrical Manufacturing Company, 1848 West Fourteenth Street, Chicago, manufacturer of wire bushings, etc., announces that it has moved its New York office to 155 West Twenty-first Street, at which place it will carry a stock of "Powerlet" fittings, "Multi" porcelain bushings and fuse cut-outs and accessories. The New York office is in charge of A. C. Walton, who has been calling on the trade in the metropolitan district during the past year and a half. This firm reports improving business.

P. A. Geier Company to Give More than $5,000 in Prizes

What is said to be the greatest sales contest ever held in merchandising Royal electric cleaners, and, likewise, the greatest ever held by a manufacturer in the electrical appliance business, is to be started Oct. 23 by the P. A. Geier Company, Cleveland. More than $5,000 is to be distributed in thirty-three cash prizes to salesmen of the company.

Allis-Chalmers Reports Net Profits of $299,796

The Allis-Chalmers Manufacturing Company for the quarter ended June 30, 1922, reports net profits of $299,796 after federal taxes, equivalent after preferred dividends to 4 cents a share on its $25,770,750 common stock, contrasted with $278,733, or $1.69 a share, on the preferred stock in the preceding quarter and $635,880, or $1.34 a share, after preferred dividends in the corresponding quarter of 1921. Unfilled orders on hand of June 30, 1922, aggregated $9,110,514.22.

Armstrong Manufacturing Company to Double Size of Plant

Contract for the erection of a building to double the size of its present plant has been let by the Armstrong Manufacturing Company, Huntington, W. Va.

The capital stock of the company has been increased from $300,000 to $500,000 to take care of this expansion, it is announced. The company manufactures a complete line of hardware and electrical specialties.

New Series of Hoover Company Sales Schools Opens

Of importance among the activities of the Hoover Suction Sweeper Company, North Canton, Ohio, which have been set in motion following the big sales convention in August was the recent opening of a new series of sales schools at North Canton.

Under the direction of E. C. Marine, the Hoover sales school will during the coming months help the Hoover men become better salesmen. During the past several months Mr. Marine has been devoting his time and energy to Hoover field schools—condensed sessions of the Hoover sales school, as it were—and has covered a great portion of the United States and Canada.

J. F. Kinder Resigns from Sales Staff of "Tuec" Company

Announcement is made by the United Electric Company, Canton, Ohio, manufacturer of portable and stationary electric cleaners, that J. F. Kinder, who has acted as Western sales manager, has resigned. The company will in the future distribute its products, the "Ohio Tuec" electric cleaner, the "Tuec" stationary cleaner and the "Tuec" swimming pool cleaner through distributors.

Move Westinghouse Krantz Works to Mansfield, Ohio

Increased business, necessitating increased production and more adequate facilities, has resulted in the transfer of the Krantz works of the Westinghouse Electric & Manufacturing Company to Mansfield, Ohio.

The Krantz works have been situated for many years at Brooklyn, N. Y., but, with a gradual increase in business, indicating a return to normal, the Krantz officials decided that the Brooklyn works were not large enough to furnish adequate facilities to meet the impending demand for production.

The transfer of the Krantz works to Mansfield offers better facilities for increased production and gives the works a location in the central part of the country with easy access to a large number of railroads and to both the Middle West and Eastern offices of the Westinghouse compnay.

Westinghouse officials expect that the

transfer of the Krantz works to Mansfield will result in quicker and better service in meeting the requirements of the trade.

Marconi Wireless Company to Raise Additional Funds

Announcement has been made by the Marconi Wireless Company, London, England, that it proposes to raise additional funds by creating £3,000,000 short-term convertible debenture stock. Of this, £1,500,000 is to be issued forthwith and the remainder when required.

Proposals involve extension of borrowing powers and an increase of ordinary capital to provide for conversion rights. A special meeting has been called for Oct. 20 to pass resolutions, one of which provides for increasing capital to £4,000,000 by creating 1,000,000 ordinary shares at £1 each.

General Electric Company Receives Motor Order

Motors totaling several hundred horsepower for the new planing mill of the Clark-Wilson Lumber Company, Portland, Ore., have recently been ordered from the General Electric Company. This mill was electrified several years ago. The company operates its own generating plant, in which Curtis turbo-generators are installed.

China Electric Company Completes Telegraph Installation

The China Electric Company of Peking and Shanghai recently completed at Hankow the first American-type telegraph plant installation for China. Prior to this time telegraph equipment for China has come from European countries and from the shops of the Chinese Telegraph Administration at Shanghai. From an American point of view the equipment used throughout the government system, while of unusually high grade and durable, is nevertheless obsolete. The "open-circuit" plan of operation is used for the Morse circuits, and Wheatstones with undulators, worked at a very moderate speed, are in use on the long trunk lines, the source of emf. being primary batteries.

Hankow has the largest telegraph office in China, and for its proposed large new office the Ministry of Communications about two years ago directed the China Electric Company to make a study of the requirements such as might be considered in a similarly sized office in America.

This study was made by an American telegraph engineer, and in time the order was placed for a majority of the apparatus recommended. The present installation consists of distributing frame, pin-jack switchboard, fuse and resistance panel, powerboard with meters, switches and an equalizing switch for battery group control, eight groups of storage batteries, couple type, 40 volts per group, half positive and half negative groups; electric tape-drying oven, motor-generator, testing instruments, Lamson tube system, all-capital-lettered standard typewriters, etc. The cost of the new equipment was $20,000 gold.

Laundryette Company Appoints New Distributors

The Laundryette Manufacturing Company, Cleveland, announces that it has added several new distributors within the last few months. Among them are the William Hall Electric Company, Dayton, Ohio; the Hayes Electric Stores, Toledo, Ohio; the Robertson Supply Company, Orlando, Fla., and the Perry-Mann Electric Company, Charleston, S. C.

The company is now shipping orders to C. Possman of Stockholm, Sweden, who has taken over the Swedish distributorship of the "Laun-Dry-Ette" and has formed a special company to handle "Laun-Dry-Ette" sales there. Through his efforts the "Laun-Dry-Ette" has been installed in the Husmodern, maintained by the league of Swedish housewives in Stockholm. This home corresponds somewhat to our model electrical home and is visited throughout the year by members of the league of Swedish housewives.

National Conduit & Cable Proxies Obtained

Charles R. Meston, chairman of the stockholders' protective committee of the National Conduit & Cable Company, Inc., New York City, announced last week that more than 6,000 stockholders, representing more than 50,000 shares, had sent in their proxies in response to a previous call issued by the committee, which is working out a reorganization plan for the company. Mr. Meston said that his committee was working in conjunction with the bondholders' protective committee.

The Lapp Insulator Company, Inc., Le Roy, N. Y., manufacturer of high-voltage insulators, has appointed the O. H. Davidson Equipment Company, 1633 Tremont Street, Denver, Colo., its representative for Utah, Colorado, southern Wyoming and northern New Mexico.

The Electric Storage Battery Company, Nineteenth Street and Allegheny Avenue, Philadelphia, has plans in progress for erection of a branch plant on property recently acquired at Belmont Boulevard and Anderson Street, Kansas City, Mo., totaling about 2 acres of land. The initial unit will be one-story and basement, 160 ft. x 220 ft., and will include an electric substation with a 50-kw. motor-generator set for factory service. It will cost about $125,000, including equipment. Hans Von Unwerth, Finance Building, Kansas City, is engineer. Construction has also been commenced on a new assembling plant on Plymouth Street, Rochester, N. Y., to be one story, 134 ft. x 134 ft.

The Metropolitan Battery Service Company, 425 Eleventh Avenue, New York, has leased property at 321 West Fifty-fourth Street for a new plant.

The Argo-Lite Appliance Company, 649 Smithfield Street, Pittsburgh, manufacturer of electric lighting appliances, etc., has purchased property at Seventh and Smithfield Streets for $300,000, improved with three buildings, and will use one of the structures for immediate expansion.

The Apex Electric Company, Washington, D. C., has leased space in the building at 336 North Charles Street, Baltimore, Md., for local works.

The Pittsburgh Meter Company, East Pittsburgh, Pa., manufacturer of electric and other meters, has plans under consideration for the erection of an addition to its plant, on a site opposite the present works, recently acquired, estimated to cost close to $135,000, including equipment.

Landers, Frary & Clark, New Britain, Conn., manufacturers of electric heating and cooking appliances, etc., has filed plans for the erection of a six-story addition to its plant on Stanley Street, to cost about $70,000.

The Dubilier Condenser & Radio Corporation, 48 West Fourth Street, New York City, has made announcement of the approval by the Board of Underwriters of the "Ducon" device. This device, in the form of an attachment plug, is designed to be attached to an ordinary lighting socket for the utilization of the electric wiring system as an antenna.

The Tiffany Electric Company, 131 Howell Street, Jersey City, N. J., manufacturer of electrical equipment, has filed plans for the erection of one-story plant addition.

The General Electric Company has purchased a tract of 175 acres of farm and wood lands at Parsippany, N. J., for the establishment of a recreation center and summer camp for employees at its works at Newark, Harrison, Ampere, Belleville and Waverly. The recreation camp now owned and operated by the company at Lake George, N. Y., has been found too far distant from the New Jersey plants to bring about the desired advantages. Arrangements will be made on the Parsippany tract for outdoor sports of all kinds, summer and winter, and it is proposed to construct a log cabin in the near future to accommodate engineers of the company at technical conferences and to make available a suitable hall for lectures and addresses now being conducted at the Harrison works. A bungalow type of building will also be constructed for a general club house for employees.

The Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa., will commence the immediate erection of a new building at Lang Avenue and Susquehanna Street, to be used for a general warehouse and operating service, estimated to cost about $150,000.

Foreign Trade Notes

POWER STATION FOR PENANG, STRAITS SETTLEMENTS. — Negotiations are under way by the municipality of Penang, Straits Settlements, according to the *Electrical Review*, for the construction of a large electric plant on the Prai wharves, from which electricity will be supplied in Penang by the means of submarine cables. Plans for the proposed station provide for an ultimate capacity of 135,000 hp. It is planned to supply electricity in the whole of Penang, Wellesley Province and possibly parts of Kedah. The wharves will be equipped with electric cranes, etc., and the tramway system is being equipped for railless electric cars.

HIGH-POWER RADIO STATION PROPOSED FOR NEW ZEALAND.—The government of New Zealand, the *Electrician* states, is considering the erection of a high-power radio station. Whether New Zealand will have a system communicating directly with Great Britain or whether it will be a link in the Empire wireless chain has not yet been decided.

PROPOSED HYDRO-ELECTRIC DEVELOPMENT IN ARGENTINA.—A scheme has been submitted to the Legislature of the Province of Mendoza, Argentina, by the Minister of Public Works, the *Electrical Review* states, providing for utilizing the water power of the Atual River for generating electricity and for the irrigation of 625,000 acres of land. It is proposed to erect a plant on the River Atual, near the town of Nihuil, to develop from 40,000 hp. to 100,000 hp. The Legislature has been asked to pass a law authorizing the calling of tenders for a concession to be granted for the installation of a plant at Nihuil. Full details of the project can be obtained from the Minister of Public Works, Mendoza, Argentina.

Foreign Trade Opportunities

Following are listed opportunities to enter foreign markets. Where the item is numbered further information can be obtained from the Bureau of Foreign and Domestic Commerce, Washington, by mentioning the number.

Purchase is desired in Switzerland (No. 3,924) for 1,000,000 porcelain sockets for outdoor signboards of normal Edison type with as few metal parts as possible.

Purchase or an agency is desired in Spain (No. 3,935) for electrical supplies, etc.

Purchase is desired in Norway (No. 3,959) for electric pocket lamps.

An agency is desired in Norway (No. 3,961) for wireless telephones.

An agency is desired in India (No. 3985) for electrical goods, etc.

An agency is desired in Argentina (No. 3,986) for electrical equipment, with the exception of wireless and telegraphic apparatus.

PROPOSED HYDRO-ELECTRIC SCHEME IN PUNJAB.—Plans for utilizing the water power of the Sutlej Valley dam and other irrigation waters to develop electrical energy, according to *Commerce Reports*, are being considered by the Punjab Electricity Board. Application to the board from British and Canadian power interests for concessions to develop the hydro-electric power involved, with a lien on the water powers of the Ravi River, have been refused and a resolution has been published by the board declaring itself unanimously in favor of a government monopoly of water power for the Punjab. It is proposed to distribute the power to concessionnaire companies and by price regulation insure electrical energy at a low cost to consumers. In this manner the board hopes to promote industrial development and at the same time safeguard the public interest in the waters of the Punjab Rivers.

PROPOSED EXTENSIONS TO VIGO (SPAIN) TRAMWAY SYSTEM.—The Vigo Electric Tramway Company, according to the *Electrician*, contemplates extending its system to the towns of Redondela, Panjon, Ramallosa, Gondomar, Bayona and Canido, a distance of about 10 miles. The cost of the work is estimated at £280,000 and will include four substations, trolley wire, converters, transformers, rolling stock, etc.

ELECTRIC EQUIPMENT FOR MUNICIPAL PLANT AT MACKAY, AUSTRALIA. —Tenders will be received by the City Council of Mackay, Queensland, Australia, according to the *Electrician*, until Jan. 31, for boiler and generating plant, switchboard and transformers. Messrs. Frew & Bridger, Queen Street, Brisbane, Australia, are consulting engineers.

PROPOSED EXTENSION TO ELECTRIC LIGHTING SYSTEM IN MANLY, AUSTRALIA.—The City Council of Manly, Sydney, Australia, the *Electrical Review* states, has decided to appropriate £25,000 for extensions to the street-lighting system and mains.

EQUIPMENT FOR THE MONSWAI (NEW ZEALAND) HYDRO-ELECTRIC PROJECT.—Tenders will be received by the Southland Electric Power Board, Invercargill, New Zealand, until Dec. 15, according to the *Electrical Review*, for turbines, generators, exciters, battery equipment, switchboards, switch gear and cables, etc., for the Monswai hydro-electric project.

New Apparatus and Publications

STOKER.—The Under-Feed Stoker Company of America, Detroit, is distributing a leaflet describing and illustrating its "Lateral Retort" stoker.

PREVENTING CORROSION.—"Heating and Deaëration of Boiler-Feed Water" is the title of a leaflet distributed by the H. S. B. W. Cochrane Corporation, Philadelphia, describing its apparatus for preventing corrosion by dissolved oxygen.

SOCKET. — The Akron Specialty Company, 824 South High Street, Akron, Ohio, has recently brought out a new socket for use with the Westinghouse dry-battery tubes, "WD-11" detector and "WR-21A" amplifier. This socket is distributed exclusively by the Moock Electric Supply Company, Canton, Ohio.

PANELBOARDS AND CABINETS. — The Sprague Electric Works of General Electric Company, 527 West Thirty-fourth Street, New York City, are distributing a leaflet covering the "Sprague" safety-type panelboards and cabinets.

SNAP SWITCH.—A new motor-operated snap switch that can be operated either on alternating or direct current and is applicable wherever the automatic operation of electrical devices is desired has recently been perfected by the Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa.

CHIMNEY CONSTRUCTION. — Ballard, Sprague & Company, Inc., 200 Fifth Avenue, New York City, engineers and contractors, have issued a small booklet in which they describe and illustrate various chimneys, boiler settings and other construction work done by the company.

SMALL MOTORS.—The Reynolds Electric Company, 2650 West Congress Street, Chicago, is distributing a leaflet calling attention to the "Reynolds" fractional-horsepower motors of the split-phase induction type. These motors are made at ratings from 1/20 hp. to ¼ hp., in six frame sizes and two diameters.

ORGAN BLOWER.—The Kinetic Engineering Company, Sixtieth Street and Baltimore Avenue, Philadelphia, is distributing a leaflet describing the "Kinetic" organ blower.

ELECTRIC PYROMETERS. — Catalog No. 1,401 issued by the Bristol Company, Waterbury, Conn., covers its various types of electric pyrometers and accessories. It also gives charts for several types of its recording pyrometers.

New Incorporations

THE SANDY RUN ELECTRIC COMPANY, Shelby, N. C., has been granted a charter with a capital stock of $25,000 to distribute electricity in the towns of Mooresboro, Lattimore, Boiling Springs and Ellenboro. The company is capitalized at $25,000.

THE BERGEN RURAL ELECTRIC COMPANY, Bergen, N. Y., has been incorporated with a capital stock of $7,200 by Clarence A. Rogers, James Stedman and others. The company will supply electricity in Bergen and vicinity.

THE FRANKLIN (MO.) ELECTRIC COMPANY has been incorporated with a capital stock of $20,000 to generate and distribute electricity. The incorporators are B. E. Perkinson, John Rogers, A. J. Alliott and others.

Construction News

Projects, Plans, Bids and Contracts, Contemplated or Under Way

New England States

STOCKHOLM, ME.—The Maine Utilities Commission has authorized the Stockholm Light & Power Company to issue $10,000 in capital stock, the proceeds to be used for the erection of transmission lines and to extend its service.

PORTSMOUTH, N. H.—Bids will be received by the Bureau of Supplies and Accounts, Navy Department, Washington, D. C., until Oct. 24 for four motors, controllers and spare parts for the local navy yard. (Schedule 216.)

BARRE, VT. — The City Council has decided to install a new lighting system on Blackwell and Washington Streets. The plans provide for the erection of 400-cp. lamps mounted on ornamental brackets. The Barre Light & Power Company furnishes the street-lighting service.

FALL RIVER, MASS.—The Richard Borden Manufacturing Company has awarded contract for the construction of a transformer and switch station, to cost between $6,000 and $7,000.

LOWELL, MASS.—The Boott Mills, Inc. has awarded the contract for the construction of a hydro-electric power plant at its local mills, to cost about $30,000.

SPRINGFIELD, MASS. — The United Electric Light Company will make extensions in its underground conduit system, to cost $50,000.

Middle Atlantic States

AUBURN, N. Y. — The Empire Gas & Electric Company has issued $1,100,000 in bonds, part of the proceeds to be used for extensions and improvements.

BUFFALO, N. Y.—Plans are under way by Peter A. Porter, Jr., Marine Bank Building, in conjunction with the James S. Thompson estate, for the organization of a company to construct and operate hydro-electric plant at Niagara Falls. The cost of the initial installation is estimated at $4,000,000.

BUFFALO, N. Y.—Plans for the proposed flour mills to be erected on the water front in Buffalo by the Pillsbury Flour Mills Company, Minneapolis, include an electric substation. The cost of the plant with equipment is estimated at $2,500,000.

LITTLE FALLS, N. Y.—The installation of an ornamental lighting system, to cost about $15,000, is under consideration.

NEW YORK, N. Y.—The American Gas & Electric Company has issued bonds for $7,500,000, a portion of the proceeds to be used for extensions and improvements.

NEW YORK, N. Y.—The Department of Plant & Structures is preparing plans for a trackless trolley system on Staten Island, to cost about $4,235,000, of which $1,235,000 will be used for a power plant. Grover A. Whalen is commissioner.

OSWEGO, N. Y.—Plans are being prepared for the construction of a municipal hydro-electric plant, on the Oswego River, to cost about $750,000. John A. Bensel, 16 East Forty-first Street, New York, is engineer.

TUPPER LAKE, N. Y. — Bids will be received by the Bureau of Yards and Docks, Navy Department, Washington, D. C., until Nov. 15 for mechanical equipment for the power house at the proposed veterans' hospital at Tupper Lake. (Specifications 4719 and 4720.)

VISCHER FERRY, N. Y.—Bids will be received by Charles L. Cadle, superintendent of Public Works, Capitol, Albany, until Nov. 1 for the construction of power house and work incidental thereto, at the Vischer Ferry dam.

NEWARK, N. J.—The City Commission will install equipment at the power house and refrigerating plant at the new Center Market, now in course of construction, as follows: Generators, engines, etc., to cost $48,000; boilers, piping, etc., $40,000; elevator equipment, $40,000; refrigerating-plant machinery, $100,000; pumping equipment, $10,000; incinerators, $10,000; lighting fixtures, $10,000, and general market apparatus, $350,000.

TRENTON, N. J.—The Board of Education has completed plans for the erection of a power plant at Clinton Avenue and Perry Street. A refrigerating plant will also be installed.

ALTOONA, PA.—The Penn Central Light & Power Company has arranged for a bond issue of $80,000, the proceeds to be used for the construction of a power plant at Saxton.

ALTOONA, PA.—The Pennsylvania Railroad Company is considering plans for the electrification of its lines between Altoona and Johnstown, to cost approximately $15,000,000, including power houses, etc.

DILLSBURG, PA. — The Cumberland Valley Light & Power Company has arranged for a merger of twelve electric power companies operating in York and Adams Counties, as follows: Franklin Township, Washington Township, Reading Township, Hamilton Township, Latimore Township, Huntington Township, Menallen Township, Tyrone Township, York Springs Borough, East Berlin Borough, Bendersville Borough, Abbottstown Borough, and the Dillsburg Light & Power companies. Extensions and improvements will be made in the power plant at Dillsburg, with new transmission and distributing lines.

EASTON, PA.—The Pennsylvania Edison Company has issued $525,000 in capital stock, part of the proceeds to be used for extensions and improvements.

LANCASTER, PA. — Work will being within sixty days by the Edison Electric Company to place its overhead transmission lines in underground conduits in the business section of the city. The conduits for carrying the cables are already in place. The cost of the new system is estimated at about $160,000.

PITTSBURGH, PA.—Bids will be received by the Board of Education, until Nov. 2 for mechanical and electrical equipment for the South High School addition, including mechanical fans, motors, lighting fixtures, boilers and auxiliary equipment. George W. Gerwig, 725 Fulton Building, is secretary.

TRAINER, PA. — The Sinclair Consolidated Oil Corporation, 45 Nassau Street, New York City, has purchased a site at Trainer for a new oil refinery. Plans have been prepared for the initial plant, to cost about $2,000,000, which will include power station, machine shop and other buildings. Other units will be erected later, increasing the cost to $5,000,000.

WILKES-BARRE, PA.—The Candlemas Collieries Company, Exchange Building, is considering the installation of electric power equipment, hoisting apparatus and mining machinery.

WILLIAMSPORT, PA.—Plans are under consideration by the City Council for an issue of $1,000,000 in bonds for municipal improvements, to include extensions to the electric plant and system.

CUMBERLAND, MD.—The Cumberland Edison Power Company, recently organized, has acquired the holdings of the Cumberland Electric Railway Company and the Edison Electric Illuminating Company, and will consolidate the properties. Extensions and improvements to the systems will be made.

FAIRMONT, W. VA.—The Monongahela Power & Railway Company will make extensions in its power plants and system to cost about $1,000,000. Additional machinery will be installed in the generating plant at Rivesville and a new 66,000-volt transmission line erected from this plant to a point on the Pennsylvania state line.

WASHINGTON, D. C.—Bids will be received by the Board of Commissioners until Oct. 24, Oct. 30 and Nov. 13 for equipment for the Eastern High School, including motor-generator set, pressure and vacuum pump and auxiliary equipment for power service.

North Central States

GREENVILLE, MICH.—Plans have been prepared by the Michigan Canned Food Company, Book Building, Detroit, for the erection of a factory and power house in Greenville, to cost about $150,000. The Industrial Construction Company, Eau Claire, Wis., is engineer.

LANSING, MICH. — The Lansing Pure Ice Company will install electrical equipment in connection with an addition to its ice-manufacturing plant, to cost about $100,000.

LORETTO, MICH.—Plans are being prepared by the Peninsular Power Company, Madison, Wis., for the construction of a hydro-electric plant, including a transmission line to cost about $225,000. Mead & Seastone, Journal Building, Madison, are engineers.

CLEVELAND, OHIO.—Bids will be received at the office of Commissioner of Purchases and Supplies, City Hall, Cleveland, until Oct. 27 for fiber conduit for the division of light and power.

CLEVELAND, OHIO.—The installation of a new ornamental lighting system on Clifton Boulevard, Detroit and Madison Avenues in the Lakewood section of the city is under consideration. The cost is estimated at $200,000. E. H. Fischer, City Hall, is engineer.

EAST LIVERPOOL, OHIO.—The Ohio & Pennsylvania Electric Company, recently organized, has acquired a site on the Ohio River, near Liverpool, for power plants to cost about $1,000,000. Blaine Graham, Steubenville, represents the new company.

LORAIN, OHIO.—The installation of a new ornamental lighting system on Broadway is under consideration.

MARION, OHIO.—The Columbus, Delaware & Marion Electric Company has issued $1,374,000 in bonds, part of the proceeds to be used for extensions and improvements.

NEWARK, OHIO.—The Ohio Power Company has issued $6,132,000 in bonds, part of the proceeds to be used for extensions and improvements.

TOLEDO, OHIO.—Work has started on the foundation of the power house at the Flower Hospital. The plans provide for the erection of seven new buildings, including power house, to cost about $1,000,000.

INDIANAPOLIS, IND.—Bids will be received by the Board of Sanitary Commissioners, City Hall, Indianapolis, until Oct. 31 for construction of section 3, division 3, and furnishing mechanical equipment for sewage-disposal plant, including coal-handling equipment, power-plant, piping, boiler-feed pumps, feed-boiler heaters, etc.

TERRE HAUTE, IND. — The Wabash Valley Electric Company contemplates the construction of a power plant on the Wabash River in Sugar Creek Township, to cost about $5,000,000. Application has been made to the County Commissioners for permission to erect extensions to its transmission system and distributing lines in Vigo County.

CASEY, ILL.—The contract for the construction of power station and installation of equipment, including generators, engines and boilers, for the municipal electric light plant has been awarded to the Power Supply Company, Terre Haute, Ind., to cost about $75,000.

EVANSTON, ILL.—A vocational department will be installed in the new high school for which bids will soon be asked. The cost, including equipment, is estimated at about $2,000,000.

BELOIT, WIS.—Plans are being prepared by the Beloit Water, Gas & Electric Company for the erection of a new office building, to cost about $150,000. Hetherton & Krieg, Goodwin Block, are architects.

MANITOWOC, WIS.—The installation of an electric lighting system on the new Eighteenth Boulevard is under consideration by the City Council.

MERRILL, WIS.—The Wisconsin Valley Electric Company has submitted a proposal to the City Council offering to install a new street-lighting system.

MILWAUKEE, WIS. — The Milwaukee Electric Light & Railway Company has issued bonds for $12,500,000, a portion of the proceeds to be used for extensions and improvements.

PORTAGE, WIS.—The Ford Motor Company is reported to have secured a site on the Wisconsin River for the construction of a hydro-electric power plant to be used in connection with its proposed zinc-oxide plant in this section. The project will cost close to $500,000.

BEMIDJI, MINN.—The Minnesota Associated Lumber Company contemplates the construction of a new mill with power plant, machine shop and other mechanical departments, to cost, including machinery, about $500,000.

BRAINERD, MINN.—The Northern Pacific Railroad Company contemplates the construction of a large power plant in Brainerd to replace the present plant.

SIOUX CITY, IOWA.—The Hanford Produce Company will install electrical equipment in connection with its proposed ice-manufacturing plant, to cost about $100,0000.

BRANSON, MO. — The Federal Power Commission has granted the Empire District Electric Company, Joplin, authority to construct a dam at Table Rock above Lake Taneycomo, 4 miles from Branson.

KANSAS CITY, MO.—Bids for the installation of a municipal underground fire-alarm system have been rejected, and new bids will be asked at an early date.

ST. LOUIS, MO.—The St. Louis Smelting & Refining Works, Inc. will install a 1,250-kw. turbo-generator set and other electrical equipment at its plant.

LINCOLN, NEB. — Extensions to the ornamental lighting system in the business district are under consideration.

YORK, NEB. — The Nebraska Gas & Electric Company will install additional equipment at its local power plant. A transmission line will be erected from Norfolk to Lindsay.

KANSAS CITY, KAN. — A new street-lighting system will be installed on the Quindaro Boulevard from Seventh to Twenty-second Street. Electric street lamps will also be erected in the Arackaree district.

Southern States

KINSTON, N. C.—Plans are being prepared for an ornamental lighting system on North and Queen Streets, to cost about $25,000.

LINCOLNTON, N. C.—Extensions and improvements are contemplated to the municipal electric lighting waterworks and sewerage systems, for which $180,000 in bonds have been authorized.

SPARTANBURG, S. C.—The South Carolina Gas & Electric Company, recently organized, has taken over the plants and holdings of the South Carolina Light, Power & Railways Company. Improvements will be made to the property, to cost about $300,000, which will include enlarging the hydro-electric plant at Gaston Shoals, improvements to the steam and gas plants in Spartanburg, erection of transmission line from Spartanburg to Gaffney, etc.

FORT MEYERS, FLA. — Preliminary plans are being prepared for the installation of a municipal light and power plant.

BIRMINGHAM, ALA.—The Public Service Commission has granted the Alabama Power Company permission to build three dams across the Tallapoosa River, to develop about 120,000 hp.; also to erect a transmission line from Lock 12 to Opelika.

BIRMINGHAM, ALA.—The Crystal Ice & Storage Company will install electrical equipment at its proposed ice and refrigerating plant on Ninth Avenue, to cost about $90,000.

SCHLATER, MISS.—The Schlater Light & Ice Company plans to rebuild its local power house, recently damaged by fire, causing a loss of about $25,000.

LITTLE ROCK, ARK.—Steps have been taken by the Seventh Street Business Men's League to install an ornamental lighting system on West Seventh Street from Main to Victoria Street.

THORTON, ARK.—Plans are being prepared by the Stout Lumber Company for rebuilding its planer and veneer mills and power house, recently destroyed by fire. The cost of the new plant is estimated at $200,000.

LAFAYETTE, LA.—The City Council is considering an issue of $144,000 in bonds for improvements and extensions to the municipal electric light plant and waterworks.

MANSFIELD, LA.—The capital stock of the Mansfield Light & Power Company has been increased by $50,000.

HEAVENER, OKLA. — The Oklahoma Gas & Electric Company, Oklahoma City, is reported to have acquired the municipal electric plant.

RED ROCK, OKLA.—Bonds to the amount of $25,000 have been approved for the installation of an electric light and power system.

DALLAS, TEX.—The Southwestern Dehydration Company, 409 Andrews Building, will construct a power house in connection with its proposed local plant, to cost about $75,000.

NEW BRAUNFELS, TEX.—The Planters & Merchants' Mills, Inc., 604 Brady Building, San Antonio, plan the construction of a hydro-electric plant to cost about $85,000.

PILOT POINT, TEX. — The Civic Improvement League contemplates the installation of a street-lighting system in the residential districts.

RALLS, TEX.—The Texas Utilities Company, Lubbock, has been granted a franchise to install an electric system in Ralls.

TEMPLE, TEX.—The Texas Power &

Light Company is planning to place its wires underground, at a cost of about $40,000.

Pacific and Mountain States

OLYMPIA, WASH. — Application has been made to the State Engineer for permission to utilize water from the Cowlitz River for a municipal hydro-electric power plant.

OLYMPIA, WASH. — The West Coast Pulp & Paper Company, Salem, Ore., will construct an electric substation in connection with its proposed paper mill here.

PORT TOWNSEND, WASH.—The Discovery Bay Logging Company plans to rebuild its mill and power plant, recently destroyed by fire, causing a loss of about $500,000, including equipment.

SEATTLE, WASH.—The installation of a lighting system on Olive and East Olive Streets has been approved by the Council.

TACOMA, WASH.—The installation of an ornamental street-lighting system on Broadway from South Seventh Street to North First Street has been approved by the Council.

BANNING, CAL. — Arrangements are being made by the City Trustees to take over the local electric plant, to be owned and operated by the Municipality, for which bonds have been issued.

BANNING, CAL.—Contracts have been awarded by the San Gorgonio Power Company, First National Bank Building, for the construction of two power house on the diverted Whitewater River, one to be located at Big Oaks and the other near Camp Comfort, to cost about $500,000. Later a third power house will be erected at a cost of about $400,000. The Southern Sierras Power Company, it is understood, is under contract to purchase all electrical energy developed.

GRASS VALLEY, CAL. — The Nevada Irrigation Company has applied to the State Water Commission for permission to construct two hydro-electric power plants on the Bear River, of 34,000-hp. and 28,000 hp. capacity, respectively.

HAYWOOD, CAL.—Plans are being prepared for the installation of an ornamental lighting system in the business district. J. B. Holly is engineer.

NEWPORT BEACH, CAL. — An ornamental lighting-system will be installed on the new municipal pier.

SAN BERNARDINO, CAL.—A co-operative plan is being arranged between this city and Colton for the installation of a joint lighting system on South Mount Vernon Avenue between the two municipalities.

SAN BUENAVENTURA, CAL. — Plans are in progress for the installation of an ornamental street-lighting system in district No. 4.

SAN FRANCISCO, CAL.—Roy H. Elliott, 1213 Hobart Building, and associates have plans in progress for hydro-electric power plants on Sardine and Salmon Creeks, to develop 113,000 hp., at a cost of about $1,000,000.

POLSON, MONT.—The Montana Power Company contemplates the construction of a new power plant in Polson.

Canada

EDMONTON, ALTA. — The Municipal Electric Light and Power Department is planning to extend the lighting system to North Edmonton.

KERRISDALE, B. C.—The Council is considering a bylaw to appropriate $200,000 for the installation of a municipal street-lighting system.

BARTON, ONT.—The establishment of a hydro-electric plant and commission is under consideration by the Township Council.

LONDON, ONT. — The Public Utilities Commission is considering placing underground all electric wires in the business district.

NIAGARA FALLS, ONT.—A bylaw providing $100,000 for extensions and improvements to the electric lighting system has been approved by the City Council.

SHAWINIGAN FALLS, QUE. — The Shawinigan Water & Power Company is planning extensions to its system soon. In the spring construction work will be started on the proposed power development at Gres Falls, which will involve an expenditure of from $10,000,000 to $15,000,000.

STURGEON FALLS, ONT.—The Lower Sturgeon Power Company is planning to build a power plant, to cost about $1,250,000. Vielé, Blackwell & Buck, 49 Wall Street, New York City, are engineers.

Electrical Patents

Announced by U. S. Patent Office

(Issued Sept. 26, 1922)

1,430,388. WIRE-STRETCHING TOOL; J. W. Leslie, Evanston, Ill. App. filed Oct. 25, 1920. Used for reinforcing boxes, etc.

1,430,421. STERILIZER; A. J. Walter, Mansfield, Ohio. App. filed Sept. 15, 1920. Holder for razors and other edge tools.

1,430,438. ELECTRIC FORGING AND HEAT-TREATING FURNACE; F. G. Dawson, Detroit, Mich. App. filed Jan. 11, 1922. Complicated automatic controllers eliminated.

(Issued Oct. 3, 1922)

1,430,528. MOTOR-CONTROL SYSTEM; B. O. Austin, Wilkinsburg, Pa. App. filed Nov. 12, 1920. Means for disconnecting impaired railway motor from control system.

1,430,534. SYSTEM OF CONTROL; A. H. Candee, Forest Hills, Pa. App. filed Nov. 20, 1920. Interlocking the two controllers on railway car.

1,430,548. HUMIDIFYING APPARATUS; O. D. Hogue, Brookline, Mass. App. filed Jan. 6, 1922. Complete humidifying unit with electric heating element.

1,430,549. SYSTEM OF CONTROL; G. H. F. Holy, Pittsburgh, Pa. App. filed Dec. 2, 1920. Excess number of field-magnet turns to give greater speed range.

1,430,550. X-RAY APPARATUS; G. Hotaling and W. D. Coolidge, Schenectady, N. Y. App. filed June 30, 1919. Protective device reduces danger of injury by electric shock to operators.

1,430,594. TROLLEY CLAMP; W. Schaake, Pittsburgh, Pa. App. filed Sept. 8, 1919. Clamp for holding grooved wire.

1,430,603. SOLDERING IRON; W. A. Timm, Berwyn, Ill. App. filed Nov. 28, 1920. Lead-in wires kept away from handle on low-voltage high-current soldering iron.

1,430,607. CONSTANT-RESISTANCE ELECTRON-DISCHARGE DEVICE; W. C. White, Schenectady, N. Y. App. filed Oct. 31, 1917. Electron tube arranged so that current varies directly as applied voltage.

1,430,619. MECHANICAL RECTIFIER; L. Bradley, East Orange, N. J. App. filed Feb. 14, 1919. Reduces destructive arcing.

1,430,674. COMBINED LIGHTNING ARRESTER AND CHOKE COIL; K. B. Narans and G. R. Gampher, Eldorado, Ill. App. filed Feb. 18, 1921. Combined unit with same line terminal but arrester terminal connected to ground and coil to transformers.

1,430,686. TROLLEY POLE; J. A. Sanner, Page, W. Va. App. filed July 15, 1922. Mine locomotive pole that can be varied in length.

1,430,703. AUTOMATIC CAR, TRAIN PIPE AND ELECTRIC COUPLING; W. V. Turner (deceased), Wilkinsburg, Pa. App. filed May 22, 1919. Coupler heads rigidly locked together with means for connecting the train pipe and electric wires.

1,430,706. ELECTRIC RADIATOR; J. G. Wallman, Oakland, Cal. App. filed Sept. 25, 1920. Governor switch cuts out one or more units as temperature rises above predetermined degree.

1,430,711. BRAKING SYSTEM; C. C. Whittaker, Pittsburgh, Pa. App. filed Nov. 29, 1920. Electric braking for motor vehicles.

1,430,712. DYNAMO-ELECTRIC MACHINE; H. M. Wood, Edgewood Park, Pa. App. filed Feb. 3, 1917. Generating unit at center of frame and motor armatures assembled around this in same frame and geared to generator armature.

1,430,724. ARTICLE OF FUSED METALLIC OXIDE AND PROCESS OF PRODUCING THE SAME; A. L. D. d'Adrian, Washington, Pa. App. filed Feb. 25, 1921. Has high refractory and chemical resisting qualities.

1,430,726. MANUFACTURE OF DRY CELLS; H. de Olaneta, New Haven, Conn. App. filed Feb. 24, 1920. Depolarizer comprising purified manganate derivative.

1,430,727. MANUFACTURE OF DRY CELLS; H. de Olaneta, New Haven, Conn. App. filed April 1, 1920. Method of assembling cells.

1,430,728. MACHINE FOR ASSEMBLING DRY CELLS; H. de Olaneta, New Haven, Conn. App. filed May 19, 1920. Apparatus for squeezing paste around cartridge.

1,430,785. METHOD OF PRODUCING CHLORINE GAS; G. N. Blanchard, San Francisco, Cal. App. filed July 21, 1920. Apparatus for uniformly producing chlorine gas in fixed ratio to water for water purification.

1,430,808. TWO-WAY IMPEDANCE EQUALIZER FOR TRANSFORMERS; R. S. Hoyt, Brooklyn, N. Y. App. filed Nov. 29, 1918. Telephone network arrangement.

1,430,830. ELECTRIC FLATIRON; W. A. Morgan, Los Angeles, Cal. App. filed Aug. 31, 1921. Protection afforded to prevent overheating.

1,430,844. METHOD OF CLEANSING MOLDS; A. R. Payne, Clarksburg, W. Va. App. filed Nov. 13, 1920. Electrochemical process for loosening scale on mold.

1,430,855. APPARATUS FOR AUTOMATICALLY ELECTROPLATING METALLIC SHEETS BY MEANS OF A REVOLVING CYLINDER; M. Schlotter, Berlin, Germany. App. filed Jan. 21, 1920.

1,430,858. ELECTRICALLY HEATED FURNACE; C. W. Speirs, Battersea, London, England. App. filed Oct. 5, 1920. Plate supporting crucible carried on centering device.

1,430,860. ELECTRIC LAMP; R. Swimmer, New York, N. Y. App. filed Nov. 24, 1919. Eye shields detachably connected to shade.

1,430,861. ELECTRIC FURNACE; B. Tang, Schenectady, N. Y. App. filed Dec. 11, 1920. Supporting structure for heaters of resistance furnaces.

1,430,862. DYNAMO-ELECTRIC MACHINES; H. W. Taylor, Bilton, F. H. Clough, Hillmorton, and F. P. Whitaker, Rugby, England. App. filed June 10, 1919. Windings arranged to avoid local or unbalanced currents.

1,430,863. DYNAMO-ELECTRIC MACHINE; H. W. Taylor, Bilton, England. App. filed Aug. 27, 1919. Windings so arranged that any voltage unbalance in them is prevented.

1,430,866. COMMUTATOR CONSTRUCTION; T. W. Varlye, New York, N. Y. App. filed March 5, 1920. Withstands high speed even though constructed of large size.

1,430,869. SEMI-AUTOMATIC COIL-WINDING MECHANISM; C. A. Wickstrom, Chicago, Ill. App. filed Sept. 22, 1919. Machine for the winding of universal wound coils.

1,430,883. SIGNAL RECEIVING SYSTEM; B. Bradbury, Schenectady, N. Y. App. filed March 23, 1921. Two grid tubes employed.

1,430,907. ELECTRIC ARC MECHANISM FOR SEARCHLIGHTS; L. C. Josephs, Jr., United States Army. App. filed June 9, 1919. Movement of the negative carbon so limited as to prevent abrupt changes in arc length.

1,430,926. VAPORIZER FOR INTERNAL-COMBUSTION ENGINES; J. R. Schmidt, Marion, Kan. App. filed Feb. 28, 1921. Heating element stretched over manifold opening.

1,430,927. ELECTRICALLY HEATED BOILER; E. L. Smalley, South Orange, N. J. App. filed Aug. 2, 1921. Relates to boilers of fire-tube type provided with resistance condustors carried within the boiler tube.

1,430,939. PORTABLE ELECTRIC LAMP; A. E. Case, Marion, Ind. App. filed April 30, 1920. Flashlight with case insulated from battery.

1,430,948. ELECTRICAL FURNACE FOR TREATING ORES; A. Counas, Paris, France. App. filed Aug. 21, 1920. Enables complete treatment of ores to be carried out in one furnace.

1,430,971. METHOD OF AND MEANS FOR REDUCING ORES IN ELECTRIC BLAST FURNACES; E. Fornander, Sandviken, Sweden. App. filed April 14, 1922. Method of carrying out independent introductions of ore and reducing materials.

1,430,987. ELECTRIC FURNACE; E. A. Hanff, Pittsburgh, Pa. App. filed March 27, 1920. Operator can control voltage and power factor.

1,431,014. ELECTROLYTIC CELL; E. A. Le Sueur, Ottawa, Ont., Can. App. filed Oct. 23, 1920. Current leading-in member of carbon surrounded by an open water bath.

1,431,022. AGITATING APPARATUS FOR TANKS; T. H. Mumford, Jr., Washington, D. C. App. filed March 2, 1921. Means for agitating liquids in electroplating tanks.

1,431,031. BLOWTORCH; R. E. Patchel, Philadelphia, Pa. App. filed March 31, 1921. Liquid fuel electrically heated and vaporized.

1,431,039. ELECTRIC SOLDERING IRON; F. F. Quednow and G. J. Vokel, Philadelphia, Pa. App. filed Oct. 27, 1921. Various degrees of heat may be applied.